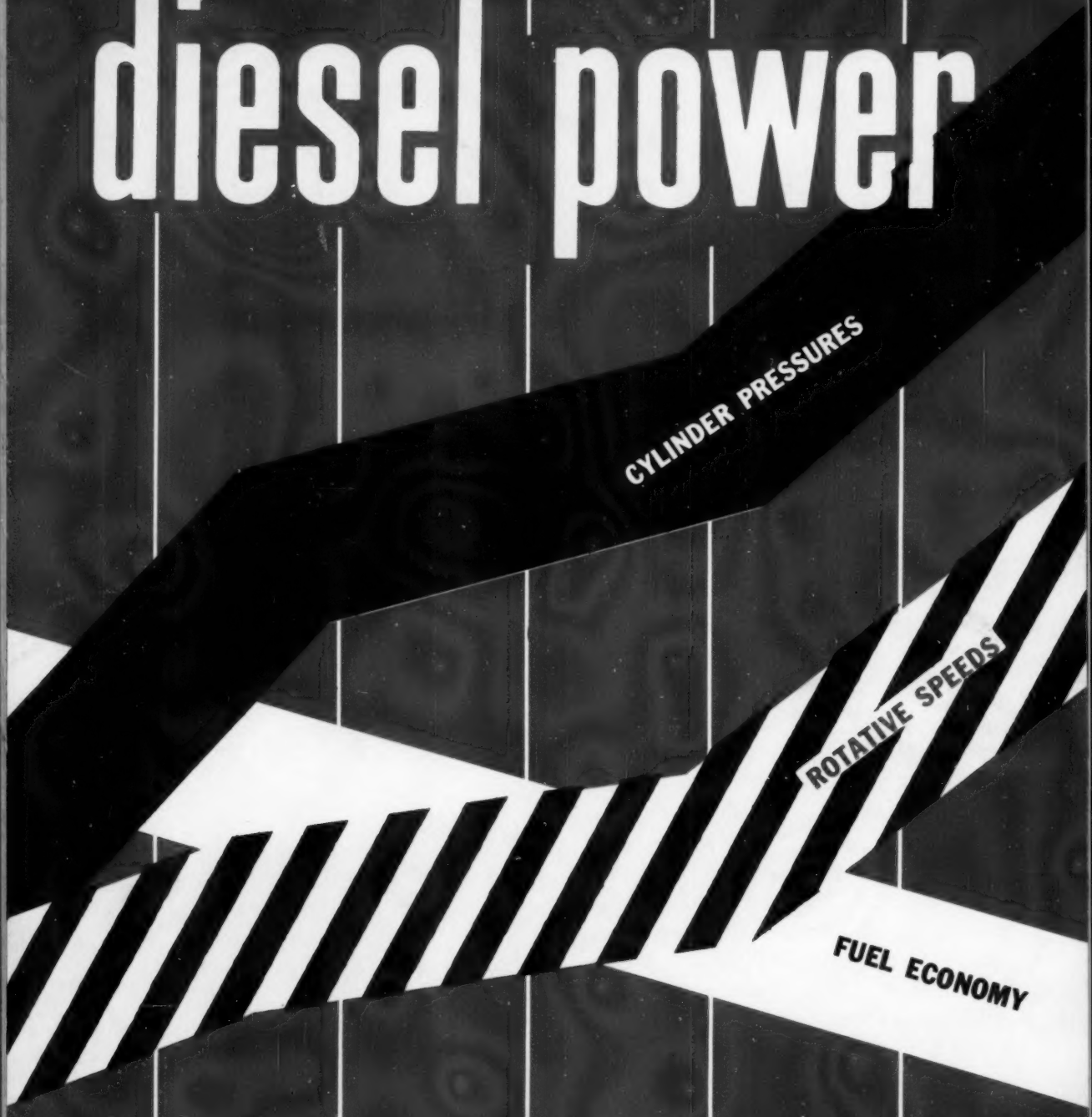
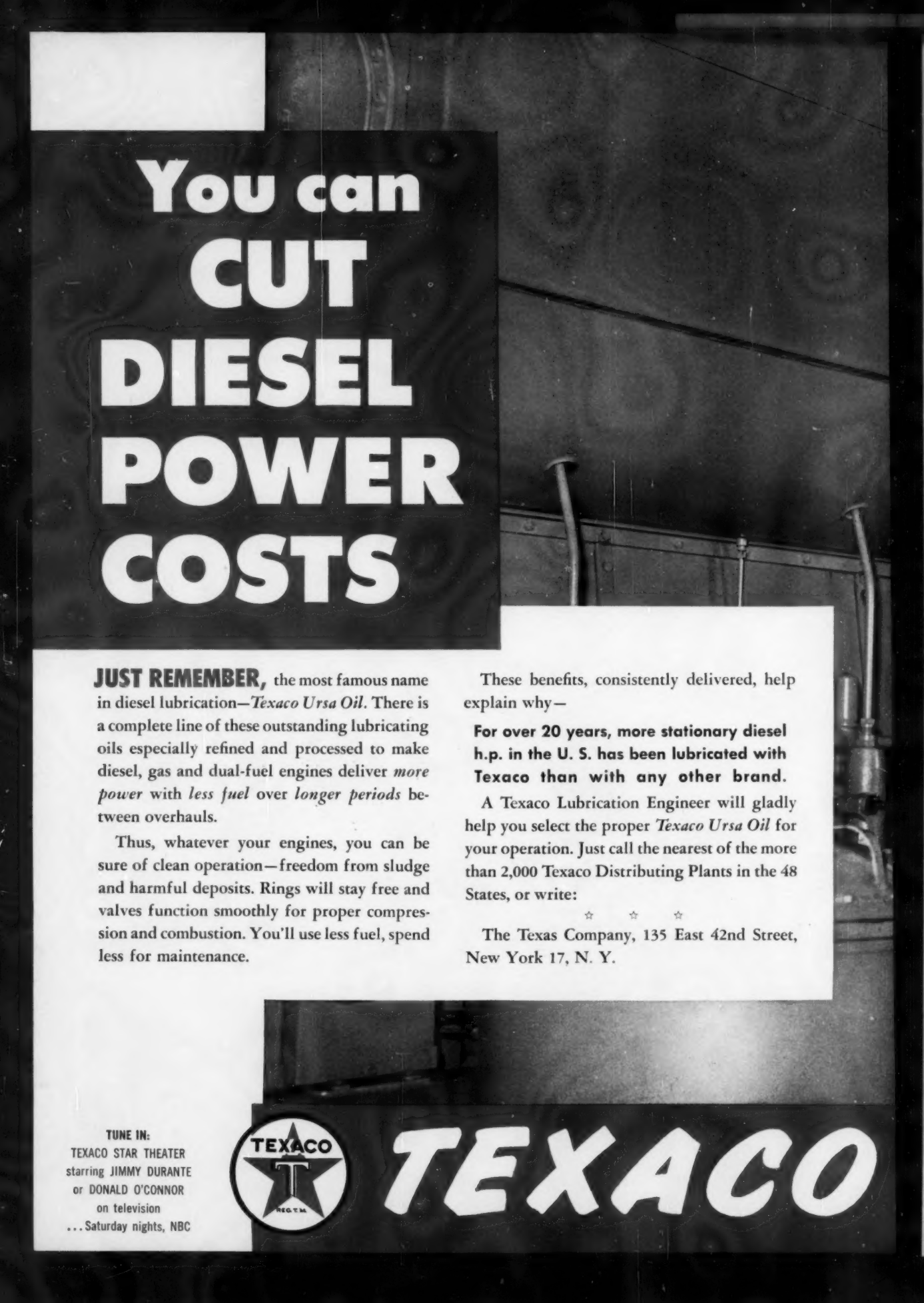
diesel power



June 1955



You can CUT DIESEL POWER COSTS

JUST REMEMBER, the most famous name in diesel lubrication—*Texaco Ursa Oil*. There is a complete line of these outstanding lubricating oils especially refined and processed to make diesel, gas and dual-fuel engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

Thus, whatever your engines, you can be sure of clean operation—freedom from sludge and harmful deposits. Rings will stay free and valves function smoothly for proper compression and combustion. You'll use less fuel, spend less for maintenance.

These benefits, consistently delivered, help explain why—

For over 20 years, more stationary diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer will gladly help you select the proper *Texaco Ursa Oil* for your operation. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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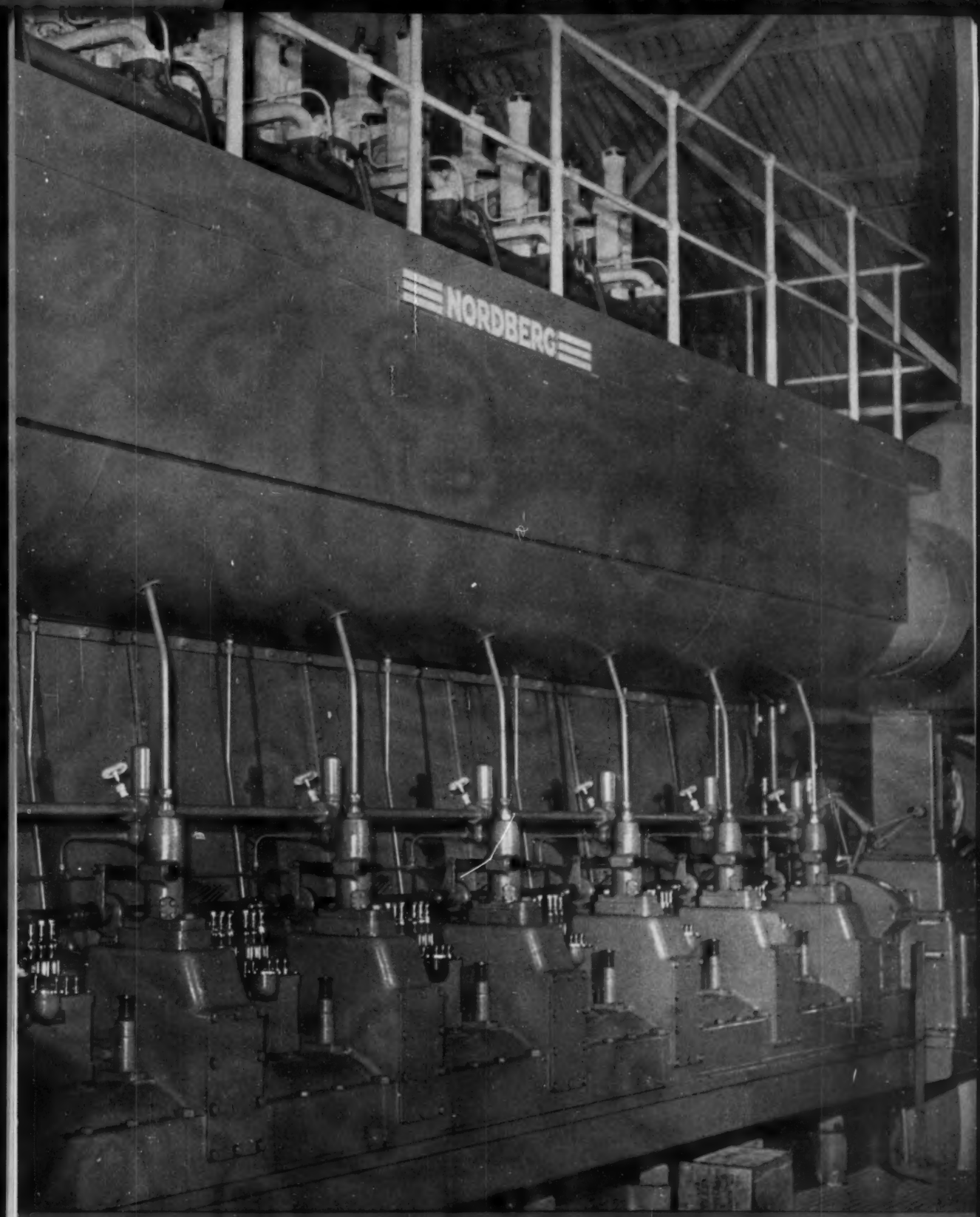


URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

ELECTRIC POWER

DELCO-REMY HEAVY-DUTY A.C. GENERATORS

Delco-Remy A.C. generators with companion regulators and rectifiers are the hearts of 12-volt A.C.-D.C. electrical systems designed specifically for modern Diesel buses with fluorescent lighting and extra-heavy electrical loads.

Desirable performance characteristics include cut-in at low generator rpm . . . maximum outputs (ranging up to 180 amperes) at low to medium speeds. The new generators supply not only alternating current for fluorescent lights but also ample direct current for the heaviest electrical loads coupled with lengthy engine-at-idle periods.

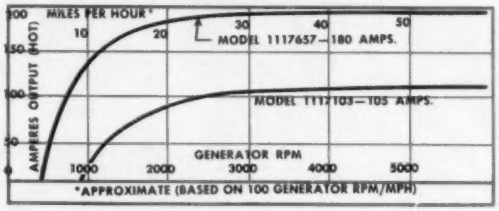
Impressive features of the new generators are their light weight, very high output capacity, and ability to operate over a wide speed range with greatest efficiency. Specify Delco-Remy electrical equipment on your new buses.

A.C. GENERATOR PERFORMANCE DATA (HOT)

Model	Volts	Cut-In RPM	Curb Idle Amperes*	Maximum Amperes	Power Watts SAE	Recommended For
1117103	12	960	5	105	1575	All speeds.
1117657	12	550	130	180	2700	All speeds.
1117062-3-4	6	750	38	90	720	All speeds.

*APPROXIMATE (BASED ON 1000 GENERATOR RPM)

A.C. GENERATOR OUTPUT CURVES (HOT)



*APPROXIMATE (BASED ON 100 GENERATOR RPM/MPH)

DELCO-REMY HEAVY-DUTY D.C. SPLIT-FIELD GENERATOR (120-Ampere Output Capacity)

The Delco-Remy 12-volt split-field generator and its companion regulator are rugged and dependable—designed to meet the needs of Diesel transit buses having increased electrical loads coupled with a high percentage of engine idling time.

Desirable performance characteristics include low cut-in, maximum output at less than 1,000 generator rpm. Note performance table at right.

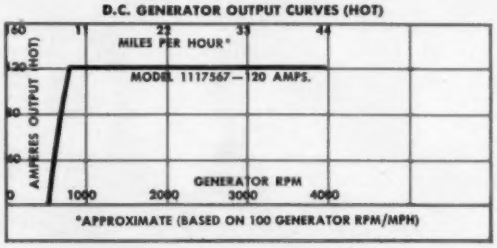
Operating benefits include reduced battery cycling, long battery life, and a simplified electrical system with sustained voltage—at no sacrifice in ruggedness or dependability.

D.C. GENERATOR PERFORMANCE DATA (HOT)

Model	Volts	Cut-In RPM	Curb Idle Amperes*	Maximum Amperes	Power Watts SAE	Recommended For
1117567	12	560	120	120	1800	Low speed & idling.

*APPROXIMATE (BASED ON 1000 GENERATOR RPM)

D.C. GENERATOR OUTPUT CURVES (HOT)

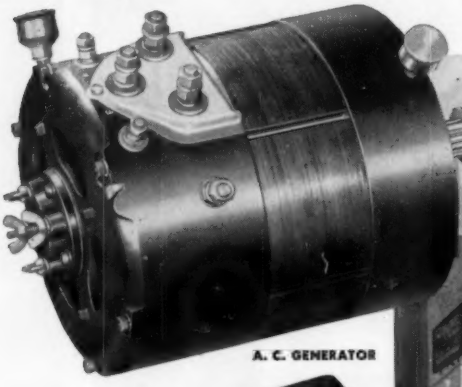


*APPROXIMATE (BASED ON 100 GENERATOR RPM/MPH)

Delco-Remy
ELECTRICAL SYSTEMS

DELCO-REMY • DIVISION OF GENERAL MOTORS • ANDERSON, INDIANA

right for the job



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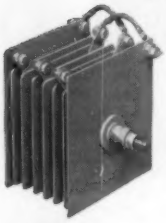

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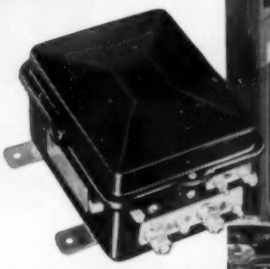
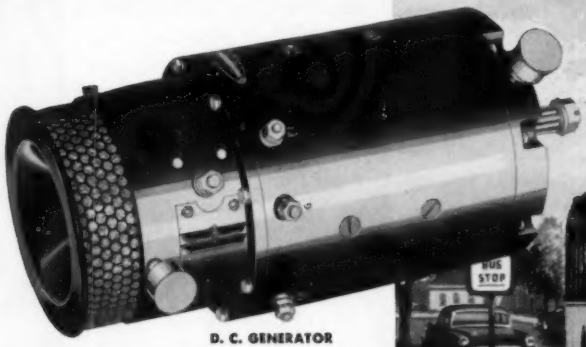


REGULATOR



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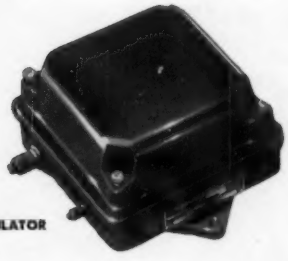
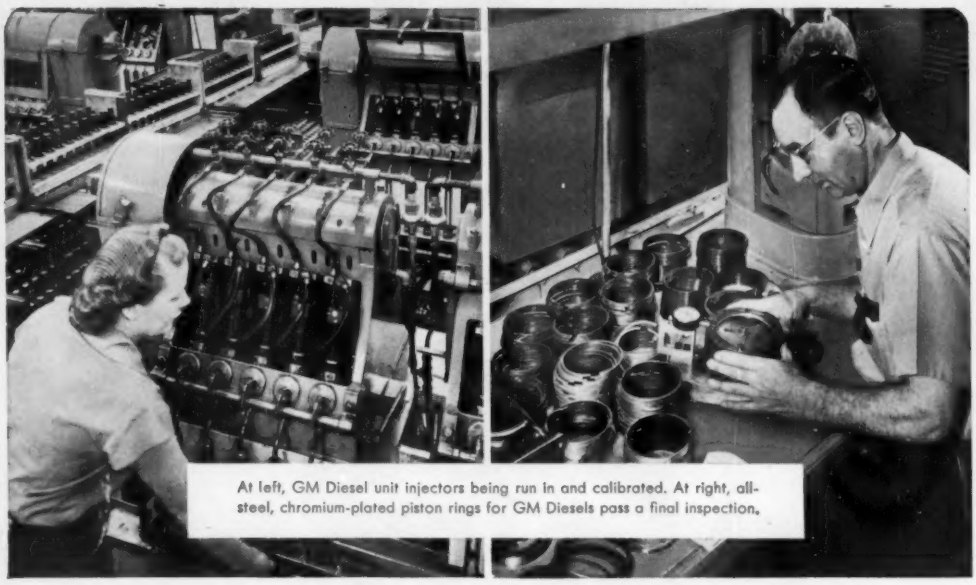


REGULATOR

WHEREVER WHEELS TURN OR PROPELLERS SPIN



At left, GM Diesel unit injectors being run in and calibrated. At right, all-steel, chromium-plated piston rings for GM Diesels pass a final inspection.

IT PAYS TO GET FACTORY-ENGINEERED

GM DIESEL PARTS

You put yourself dollars ahead and leave breakdowns behind when you buy genuine General Motors Diesel parts.

First, you get highest quality—quality that comes from continuous research and constant improvement by GM engineers—quality assured by precision manufacturing methods, checked by the most rigid tests at every stage of production.

Second, you pay less because mass production makes it possible to manufacture parts at lower cost.

Third, you get latest improvements because *only* genuine General Motors Diesel parts and components have *all* the improvements originated by our engineers at the factory.

Fourth, you get longer-wearing parts—parts proved in billions of hours of service on the toughest jobs.

Next time you need replacement parts for your GM Diesel, get *genuine* factory-engineered parts. You'll keep your Diesel running right—*get more work at less cost on every job.*

DETROIT DIESEL ENGINE DIVISION
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diesel power

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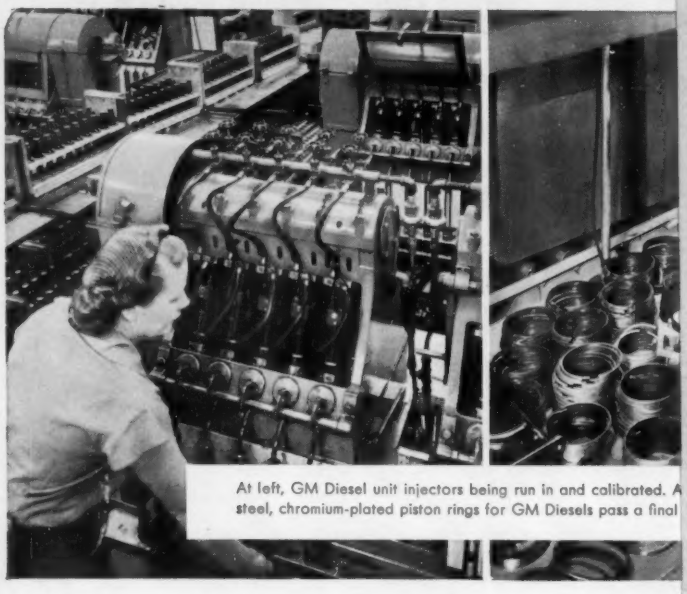

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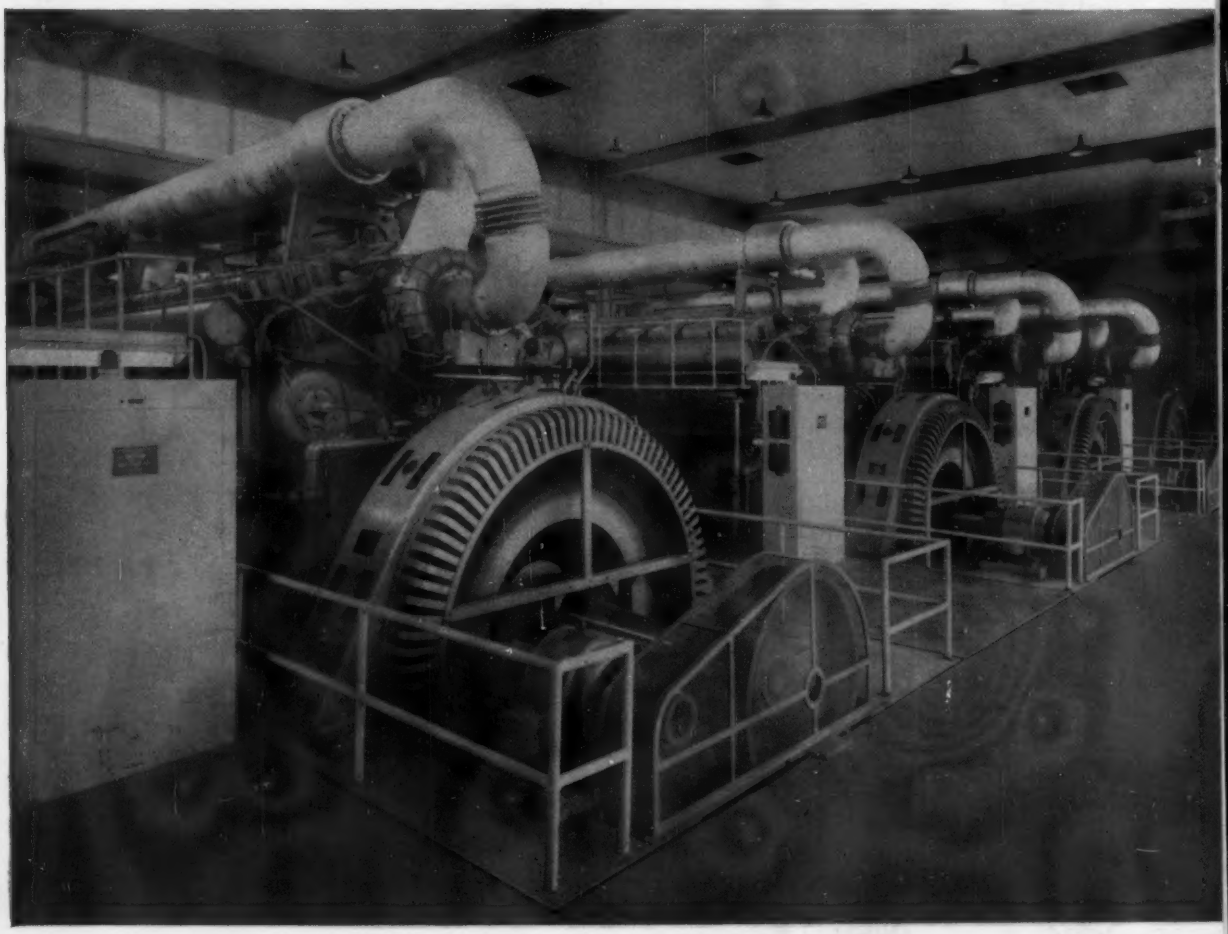
Gulf Dieselmotive

contributes to efficiency record

Modern office building and plant of the M & A Electric Power Cooperative, Poplar Bluff, Missouri, winner of the 1954 Diesel Progress Efficiency Award.

Gulf Dieselmotive Oil provides the vital lubrication for these four Cooper-Bessemer 16-cylinder Diesels in the M & A Plant.



Oil

at award-winning Diesel plant

The M & A Electric Power Cooperative of Poplar Bluff, Missouri, has been named winner of the 1954 Diesel Progress award for the most efficiently operated REA internal combustion plant.

Gulf Dieselmotive Oil provides the kind of lubrication necessary for such an award-winning performance! This modern Diesel lubricant protects the four Cooper-Bessemer 16-cylinder Diesel engines in the M & A Plant against excessive wear, and contributes to efficient operation and lower maintenance costs.

Here's why:

1. Effective detergent action prevents harmful piston ring belt deposits.
2. Base stocks are selected for their ability to help prevent hard deposits on the piston crown and in the ring belt area.
3. 100% solvent refining (removing undesirable constituents) insures greater stability and better bearing protection.

Investigate the operating savings possible with Gulf Dieselmotive Oil in your Diesels. Contact your nearest Gulf office today and have a Gulf Sales Engineer recommend the proper grade.

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THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

NEW POWER PACKAGE in dramatic debut!

AiResearch Turbocharger makes major boost in horsepower on huge Caterpillar D9 diesel tractor!

MIGHTIER THAN EVER BEFORE, the new giant Caterpillar D9 Tractor equipped with a small but potent AiResearch Turbocharger pushed record tons of dirt during tests at Proving Grounds and in the field. Application of this Turbocharger to these big tractors increased their original horsepower to their present brawny rating.

The Caterpillar Tractor Co. pioneered the installation of AiResearch Turbochargers as standard equipment on production machinery...with exciting results! Never before in earthmoving history has such a small, light power package provided such a tremendous increase in power *...and with no additional fuel cost!*

In addition, the Turbocharger quiets the engine better than any known muffling device without any of the loss of power caused by mufflers!

The new Turbocharger, reflecting more than a decade of leadership in the development and production of radial turbines and compressors, has had more than 25,000 hours of laboratory and field testing. It again demonstrates the ability of AiResearch to produce small packages that do big jobs for industry. Your inquiry as to its adaptation and application to your equipment is invited.

THE GARRETT CORPORATION

AiResearch Industrial Division

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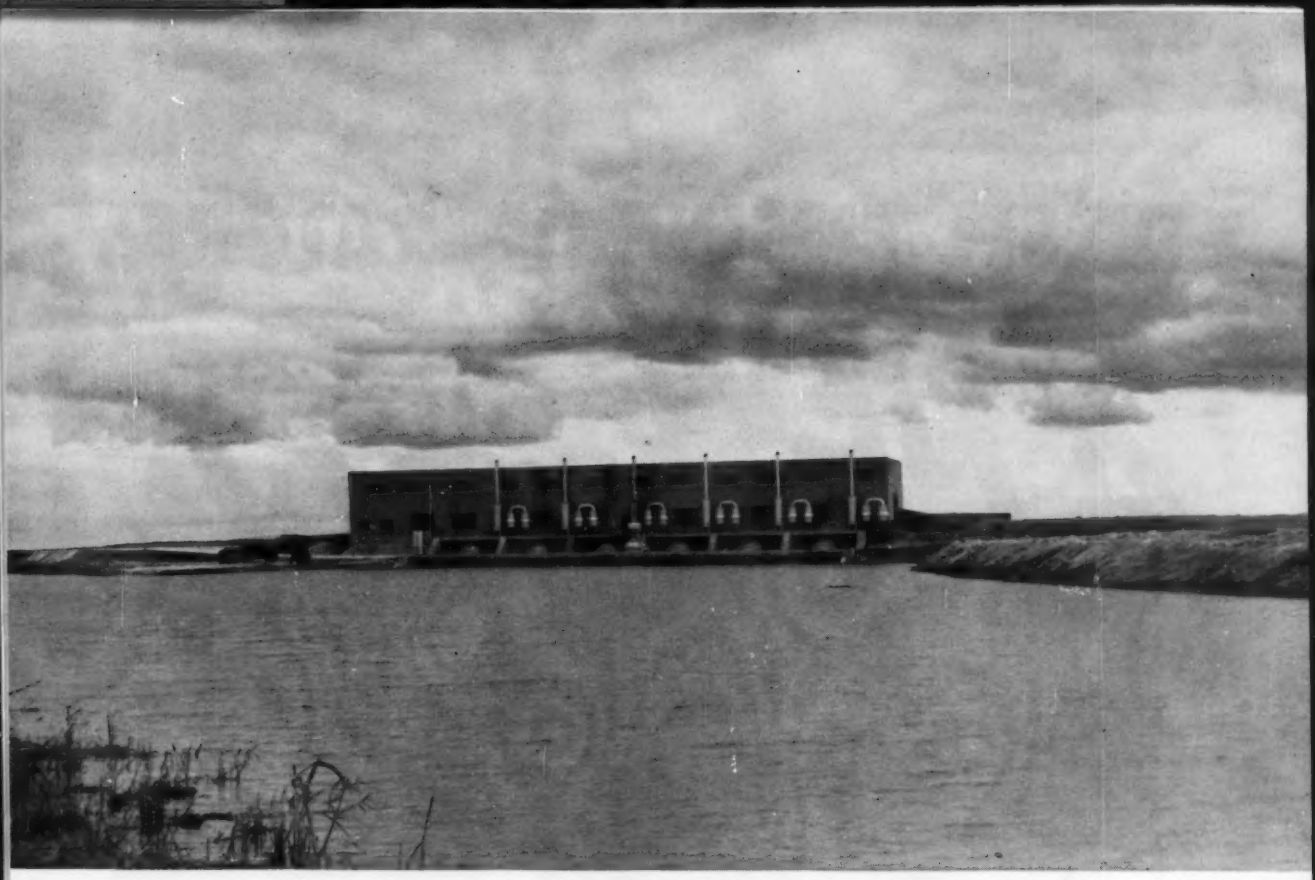
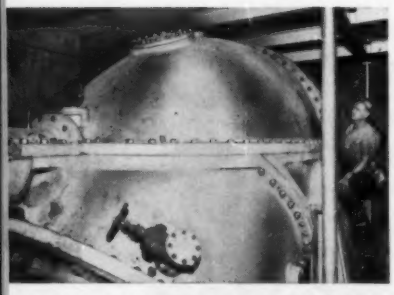
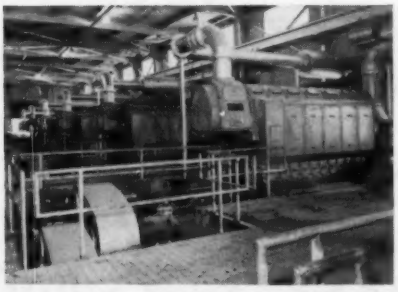
DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND RELATED MACHINERY



World's largest pumping station tames Everglades



Each giant 89-ton pump is equal to the floor space of the average-sized living room. The huge four-bladed, air-foil propeller moves water through the pump at the rate of 360,000 gallons a minute.



Six 1600-hp. Fairbanks-Morse Opposed Piston Diesel Engines insure uninterrupted power for the big pumps, especially during storm periods when they will be most urgently needed.

Floridians who have counted their flood loss in thousands of lives and millions of dollars bitterly refer to Lake Okeechobee as the Killer Lake.

Now, with the completion of the world's largest self-powered pumping station, there is the promise of forever taming the Everglades' rampaging waters.

Located at the southern tip of the lake, the station houses six of the world's largest pumps . . . built by Fairbanks-Morse . . . powered by Fairbanks-Morse Opposed Piston Diesel Engines.

Each pump can deliver over 500 million gallons a day. That's more water than is consumed each day by the entire population of Florida. Put all six of these giant 89-ton pumps in operation and you can pump nearly three times the daily consumption of the city of New York.

We at Fairbanks-Morse are proud to be a part of one of the largest engineering projects on the face of the earth—and the country-wide acceptance it typifies. This endorsement and wide selection in the F-M line of 50,000 pump models assures you of finding the *one* pump best suited to your pumping requirements. When next you need a pump, look for the one made by the world's largest pump manufacturer—Fairbanks-Morse. Ask your nearby Fairbanks-Morse Field Pump Engineer for assistance on your specific problem, or write to Fairbanks, Morse & Co., 3601 Kansas Avenue, Kansas City, Kansas.

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a name worth remembering when you want the best

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DIESEL ENGINE OPERATORS

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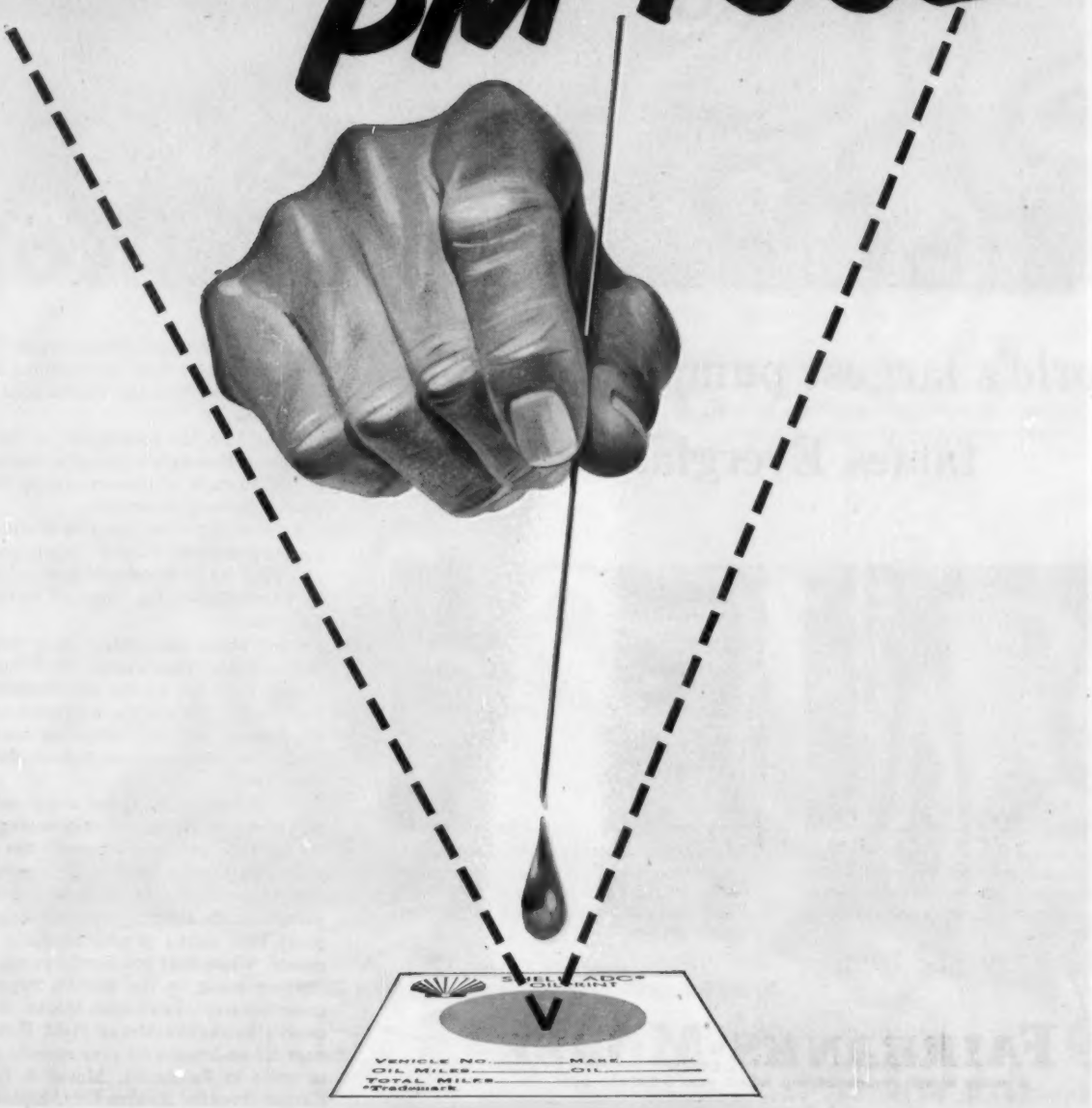

ADC* Oilprint Analysis

CHECKS CRANKCASE OIL IN MINUTES

Shell Research gives you new oil-change yardstick—

Now—operators can test crankcase oil in the short time allotted for refueling and crankcase oil checks. The Shell ADC Oilprint Analysis gives a practical and accurate oil evaluation in minutes.

ADC Oilprint Analysis means big savings when used in your preventive maintenance program . . . gives valuable information on engine and oil conditions. It answers the question "When do I change my oil?" thus eliminating the draining of usable oil and the risk of using oils loaded with contaminants.

See for yourself how the new Shell ADC Oilprint Analysis can save you money in preventive maintenance. Let us show how you can use this new service for your diesels.

SAVES... Time, Money, Engines, Oil

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SHELL

Four 1750-Horsepower GP9's delivered to **Western Maryland**

The General Purpose Diesel locomotive, designed and developed by Electro-Motive, brought a new concept of versatility and economy to railroading—a locomotive that can handle branch- or main-line passenger and freight *and* step into the yard to take on a wide range of yard and switching work. It helps railroads reach complete dieselization with a smaller number of units.

More than 16,000 General Motors Diesel locomotive units are earning money for railroads on six continents

La Grange, Illinois • Home of the Diesel Locomotive

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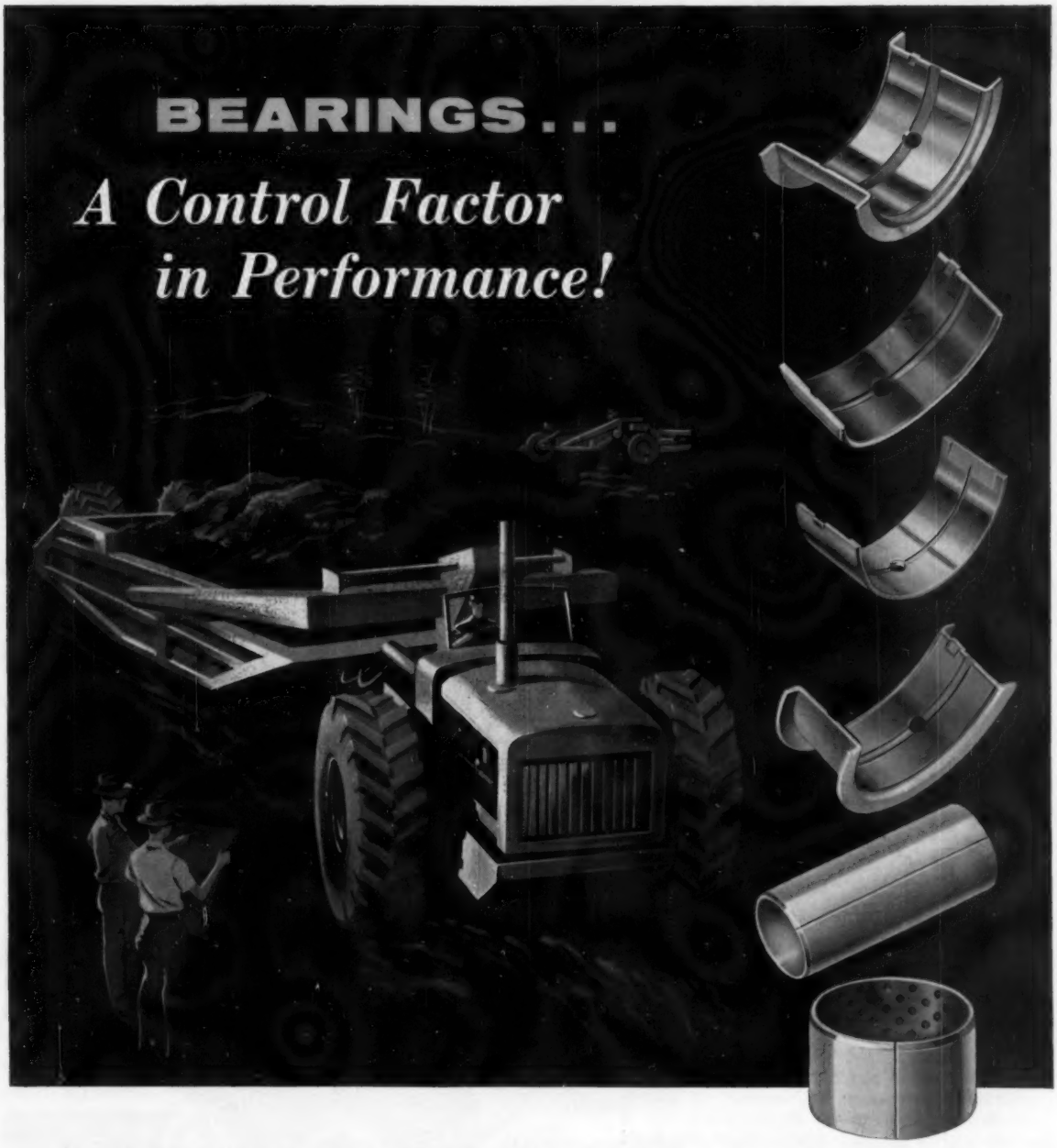
ELECTRO-MOTIVE DIVISION · GENERAL MOTORS

BEARINGS...

A Control Factor in Performance!



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Earth-moving equipment demands rugged construction in every part—and sleeve bearings are no exception. They must carry tremendous thrust loads from pistons, protect costly crankshafts from excessive wear, endure extreme heat, maintain internal lubrication and on occasion withstand around-the-clock use and abuse. Quality at every step in their manufacture is essential to their vital role in performance. We are specialists in quality bearings and bushings for engine, transmission and chassis applications, and a major supplier to the earth-moving equipment building industry. Federal-Mogul Corporation, Detroit 13, Michigan.

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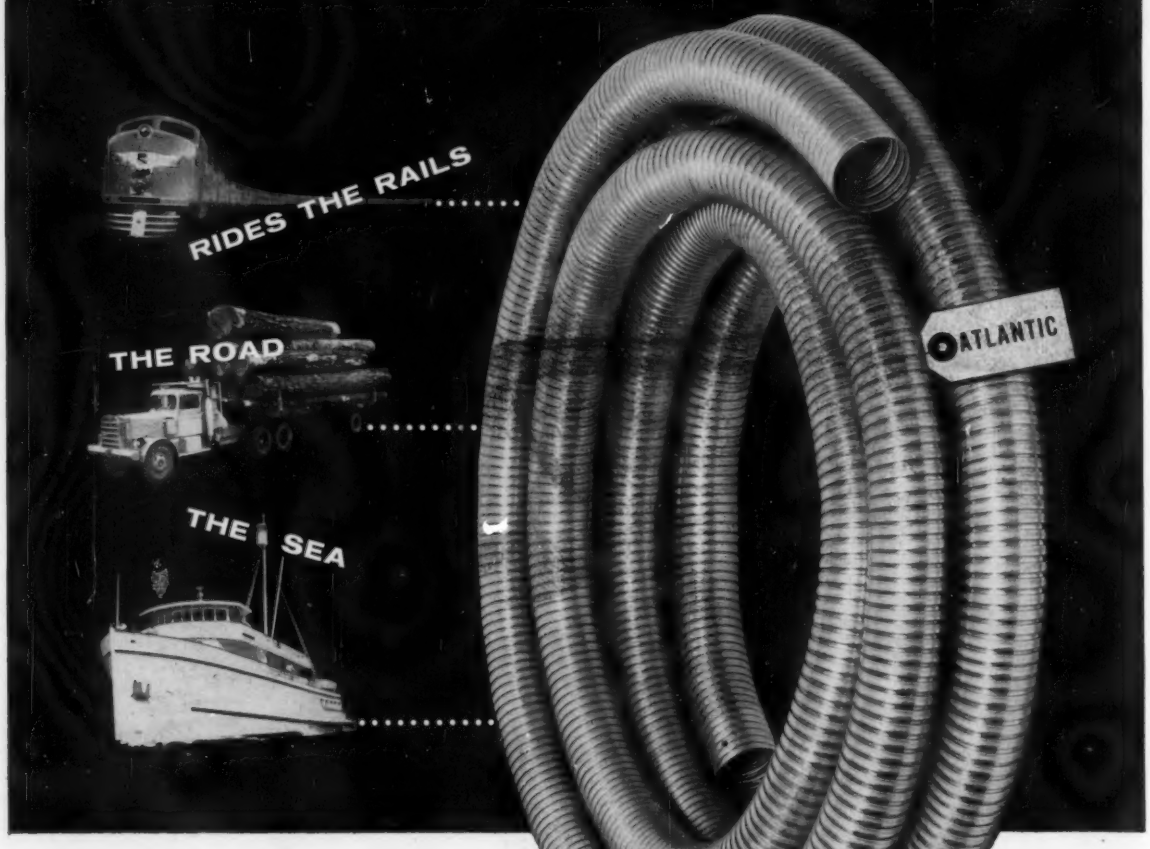

When diesels power trucks hauling 70,000 lb. loads of logs over mountain roads — or locomotives and ships, Atlantic flexible metal hose is usually given the job of guarding those vital diesel life lines—water, fuel, exhaust.

Atlantic flexible metal hose is manufactured to tough specifications.

Wall thickness is absolutely uniform. Tight against water, oil, steam, gas and air. Requires no maintenance. Atlantic flexible metal hose dampens vibration, remains flexible at higher temperatures.

There is an Atlantic flexible metal hose for each of these applications. Made in bronze, steel, stainless and monel—⅛"-36" I.D. with required fittings.

For misalignment and vibration

Write for Diesel Bulletins 1020 & 50B. See our Catalog in Sweet's Product Design File.

ATLANTIC METAL HOSE CO., INC.

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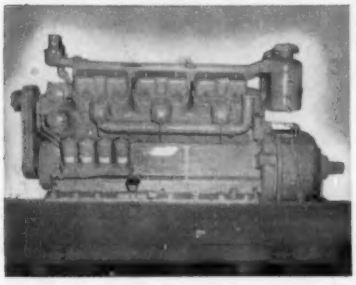
more flexibility
more wear life
more work

from new

CATERPILLAR

Torque Converter

Power Units . . .

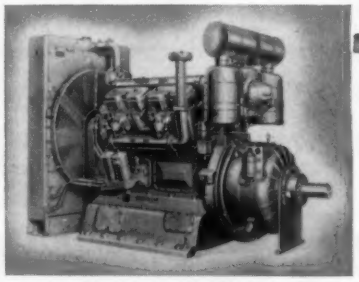


Caterpillar Torque Converter Power Unit — a Model D386 Cat Diesel working through Twin Disc Model CF Torque Converter.

FOR THE FIRST TIME, you can order any one of 6 Cat Diesel Engines *Torque Converter-equipped at the factory* . . . as complete Torque Converter Power Units, developed through design teamwork by Twin Disc and Caterpillar engineers.

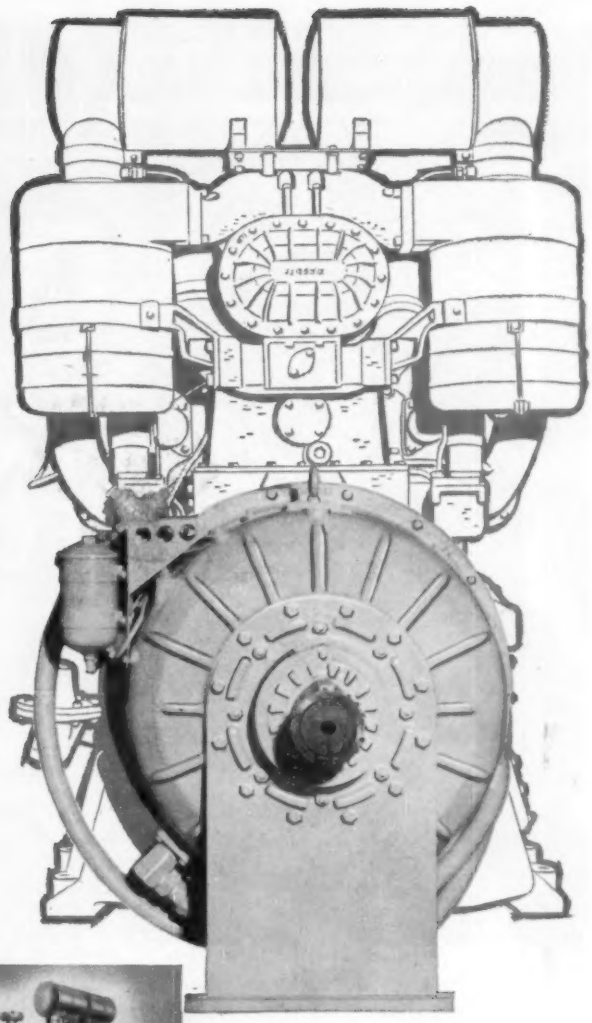
The result is *tremendous* performance—for power source and power linkage are *ideally* matched.

To give you a quick idea of how much Torque Converters mean to modern diesel power, here are a few facts you'll want to remember: on the new Cat Power Units, the Twin Disc Torque Converters • *match torque output automatically to the load* • *start loads smoothly* • *provide control of load movement without using clutch* • *prevent overloads from killing engine* • *permit hovering or holding under power* • *keep engines operating in maximum efficiency range at all times.*



Cat D375 Torque Converter Power Unit. Twin Disc Torque Converters are standard equipment.

Whether you're thinking about a new power unit or planning to replace a present one, find out how much *more* flexibility, *more* wear life, and *more work* you'll get *through Twin Disc Torque Converter Drive.* Contact your engine dealer . . . he'll give you the facts and figures.



Twelve different torque converter arrangements are available for six Caterpillar Diesels, up to 493 h.p. Twin Disc also provides a wide choice of output shafts, for both in-line and side loads.

In the meantime, if you want more details on other Industrial-Type Torque Converters, write Twin Disc, Hydraulic Division, Rockford, Ill., and ask for Bulletin 135-D. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

TWIN DISC

CLUTCHES AND HYDRAULIC DRIVES

TWIN DISC

Torque Converters

The crankshaft in the modern V-8 engine requires the ultimate in forging technique. Today's high compression engines, with continually increasing horsepower, further emphasize the importance of forging quality.

Wyman-Gordon technical know-how assures quality essential for maximum physical properties, uniform machinability and balance control . . . crankshaft forging specialists since the introduction of the internal combustion engine.

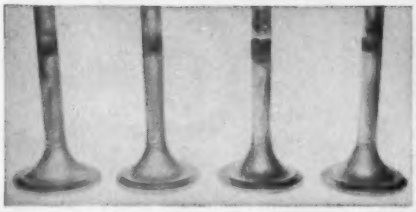
WYMAN-GORDON

Established 1883

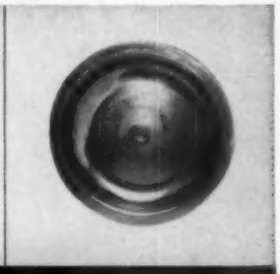
FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM

WORCESTER, MASSACHUSETTS

HARVEY, ILLINOIS DETROIT, MICHIGAN



UNRETOUCHED PHOTOGRAPHS OF ENGINE PARTS AFTER EXHAUSTIVE ROAD SERVICE TESTS USING NEW PACEMAKER RD-80 DIESEL OIL.



New Cities Service Railroad Diesel Oil 200% More Effective in Cutting Deposits

2,000,000 Test Miles of Operation with New Pacemaker RD-80 Diesel Oil Also Reveal Up To 10% Reduction in Oil Consumption. Railroads and Engine Builders Acclaim Results.

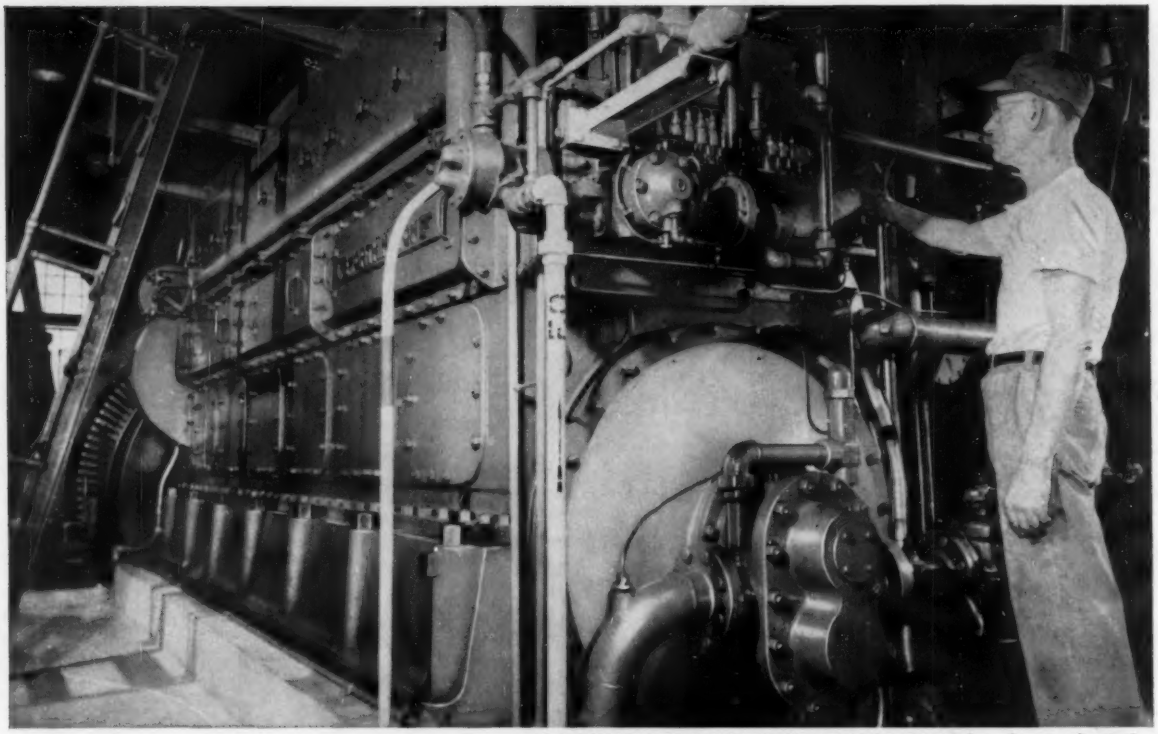
During extensive road service tests of New Pacemaker RD-80, these eight distinct advantages were apparent:

- Exceptional oxidation stability—"the best of any oil tested," according to the laboratory of one engine builder.
- 200% greater efficiency in reducing engine deposit build-up in exhaust ports and other engine parts.
- Absolutely no corrosion.
- Detergent-dispersant qualities that caused every company testing the oil to comment—"engine parts exceptionally clean."
- New protection of ring belt area due to high viscosity index of RD-80, not found in ordinary diesel oils.
- Up to 10% reduction in oil consumption.
- Reduced maintenance, resulting from wear protection that far exceeds builders' specifications.
- Heavy-duty features insure outstanding performance and fuel economy even with low-grade fuels and toughest operating conditions.

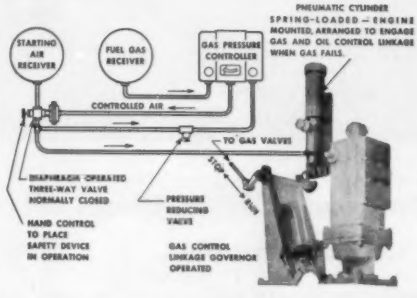
Now ready to supply this new Pacemaker RD-80 Diesel Oil to the railroad industry, Cities Service invites further inquiry. Write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



SUPERCHARGED WORTHINGTON DUAL-FUEL DIESEL is a far cry from the water wheels that furnished power for Kingman, Kansas, 49 years ago.


STARTING AIR RECEIVER
FUEL GAS RECEIVER
GAS PRESSURE CONTROLLER
PNEUMATIC CYLINDER SPRING-LOADED — ENGINE MOUNTED, ARRANGED TO ENGAGE GAS AND OIL CONTROL LINKAGE WHEN GAS FAILS.
CONTROLLED AIR
TO GAS VALVES
DIAPHRAGM OPERATED THREE-WAY VALVE NORMALLY CLOSED
HAND CONTROL TO PLACE SAFETY DEVICE IN OPERATION
PRESSURE REDUCING VALVE
GAS CONTROL LINKAGE GOVERNOR OPERATED

WORTHINGTON'S NEW "AUTOMATIC FUEL SWITCHER" used on Worthington dual-fuel engines eliminates shutdowns due to fuel gas interruptions or failures. When gas pressure drops below normal, or fails completely, the Automatic Fuel Switcher instantly and automatically changes the engine over to 100% fuel oil.

The fuel switcher closes the gas metering valves instantly and simultaneously shifts linkages that place the fuel pumps under control of the governor at the required setting for the load at that moment. There is no hunting of the governor when the engine goes over to 100% fuel oil.

From water wheels to a dual-fuel Diesel

That sums up the story of the Kingman, Kansas, municipal power plant.

Back in 1905, water wheels generated all the power for Kingman. A few years later, two steam engines replaced the water wheels to meet the city's growing power needs. In 1927, the conversion to Diesel power began: first a 130-kw engine was installed, then new Diesels were added through the years, with a 500-kw unit going into operation in late 1946.

Finally, in February, 1952, a 1000-kw, six-cylinder, supercharged Worthington dual-fuel Diesel electric unit was purchased and put into operation. This new Worthington engine-generator combination is the last word in modern power generation.

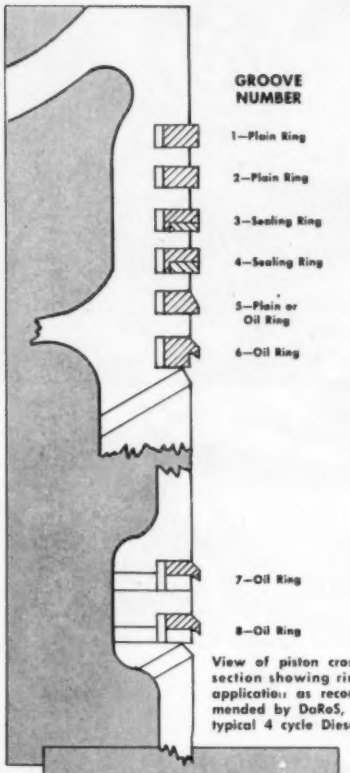
We are grateful for the opportunity of helping Kingman meet its increasing needs for power. And we're equally proud of the fine records for dependable performance and economy that our dual-fuel Diesels have been setting in municipalities throughout the nation.

Write us about your power generation problem. And ask for Bulletin S-500-B57 (Dual-Fuel Engines). Worthington Corporation, Harrison, New Jersey. E.5.5

WORTHINGTON

Economical, Continuous Power — Oil and Dual-Fuel Diesels and Spark-Ignition Engines, from 190 to 2100 bhp.

SAVE FUEL...
up to 15% with DaRoS Piston Rings



View of piston cross-section showing ring application as recommended by DaRoS, in typical 4 cycle Diesel.

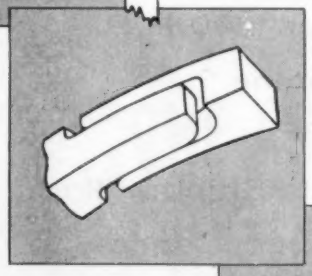
Here Are the Three Basic Reasons Why Users of DaRoS Rings Save 10% to 15% on Fuel!

1. DaRoS Rings do *not* leak—there's no blowby—no compression leakage—no loss of efficiency when you use DaRoS leakproof Sealing Rings. They successfully seal—in both new and worn cylinders. Typical DaRoS application on left shows how you can reduce compression loss—increase efficiency—save fuel up to 15%.

2. DaRoS Rings—made of Swedish Charcoal Iron—out-wear others—have a lower rate-of-wear—50% to 90% on rings and cylinders!

3. DaRoS Rings are made by Davy Robertsons Maskinfabrik — the world's first manufacturer of commercial piston rings. DaRoS furnishes original factory equipment to many of the leading engine builders. Over 50% of all of the motorships (above 1000 ton capacity) throughout the entire world are fitted with DaRoS Piston Rings.

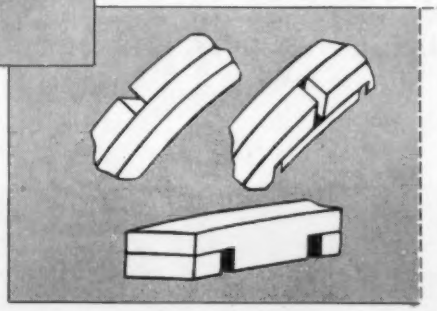
Reduce your fuel costs NOW by installing DaRoS Rings in all of your engines —wire—write or phone for prices.



IMMEDIATE DELIVERY

...from Chicago on popular sizes for Industrial Engines

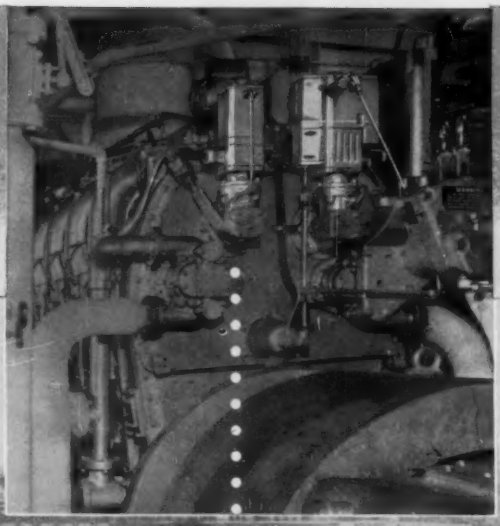
DaRoS
AMERICAN CORPORATION
D. D. COOK, President
8128 N. Lawndale Avenue
Skokie (Suburb of Chicago), Illinois U.S.A.
Distributors for North, Central and South America



ABOVE, View of DaRoS ONE-PIECE Sealing Ring #201 recommended for new cylinders. RIGHT, View of DaRoS TWO-PIECE Sealing Ring #206 recommended for worn cylinders. *(This is ad #5 in a series designed to tell Diesel Operators the important story about DaRoS Swedish Iron Piston Rings.)*

DaRoS American Corporation
8128 N. Lawndale Ave., Skokie, Illinois
Gentlemen: Send me complete information on DaRoS Rings.

NAME_____
FIRM NAME_____
STREET ADDRESS_____
CITY_____ STATE_____



Marquette HYDRAULIC GOVERNORS

• • • regulate the 12 cylinder 1200 H.P.
main propulsion Diesel engine
on the CHARLIE S.
built and operated by Davie Shipbuilding;
Ltd., of Lauzon, Levis, Quebec, Canada

The Marquette
METAL PRODUCTS CO.
CLEVELAND 10, OHIO
SUBSIDIARY OF CURTISS-WRIGHT CORPORATION

Also Manufacturers of:
ROLLER BEARING TEXTILE SPINDLES
WINDSHIELD WIPERS FOR AIRCRAFT
PRECISION PARTS AND ASSEMBLIES
FUEL OIL PUMPS AND INJECTORS
SPRING CLUTCHES
ROTARY HIGH PRESSURE OIL FIELD PUMPING MACHINERY

WANTED!

ONE PINT OF YOUR USED MOTOR OIL

REWARD: Big savings on engine repairs from information leading to the correction of hidden engine trouble.

FREE USED OIL ANALYSIS

detects hidden engine trouble

VALUABLE PURE OIL SERVICE HELPS KEEP FLEET UNITS ON THE ROAD

By analyzing just one pint of your used motor oil, Pure Oil scientists can tell you what's happening inside your fleet engine *now* and what's likely to happen in the *future*. If trouble's in the making, they can tell you how to prevent it. If operating costs are high, they can tell you how to lower them.

This valuable service—called Pure-sure Used Oil Analysis—is offered *free* to users of Pure Oil products. Many take advantage of it on a steady basis to keep their fleet units on the road all the time.

To show you how useful this free service can be to *your operation*, Pure Oil will run a Used Oil Analysis for one of your units. No obligation. Nothing to buy. Just call your local Pure Oil office or mail the coupon below.

SALES OFFICES LOCATED IN MORE THAN 500 CITIES IN PURE'S MARKETING AREA.

This offer must be limited to the 24 state area where Pure Oil products are sold.

The Pure Oil Company, Dept. 5 6 6 7
35 East Wacker Drive, Chicago 1, Illinois

Gentlemen: Without cost or obligation, please send me information on how to receive a free Pure-sure Analysis on my used oil.

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____

BE SURE PURE WITH PURE

be sure with **PURE**

5054

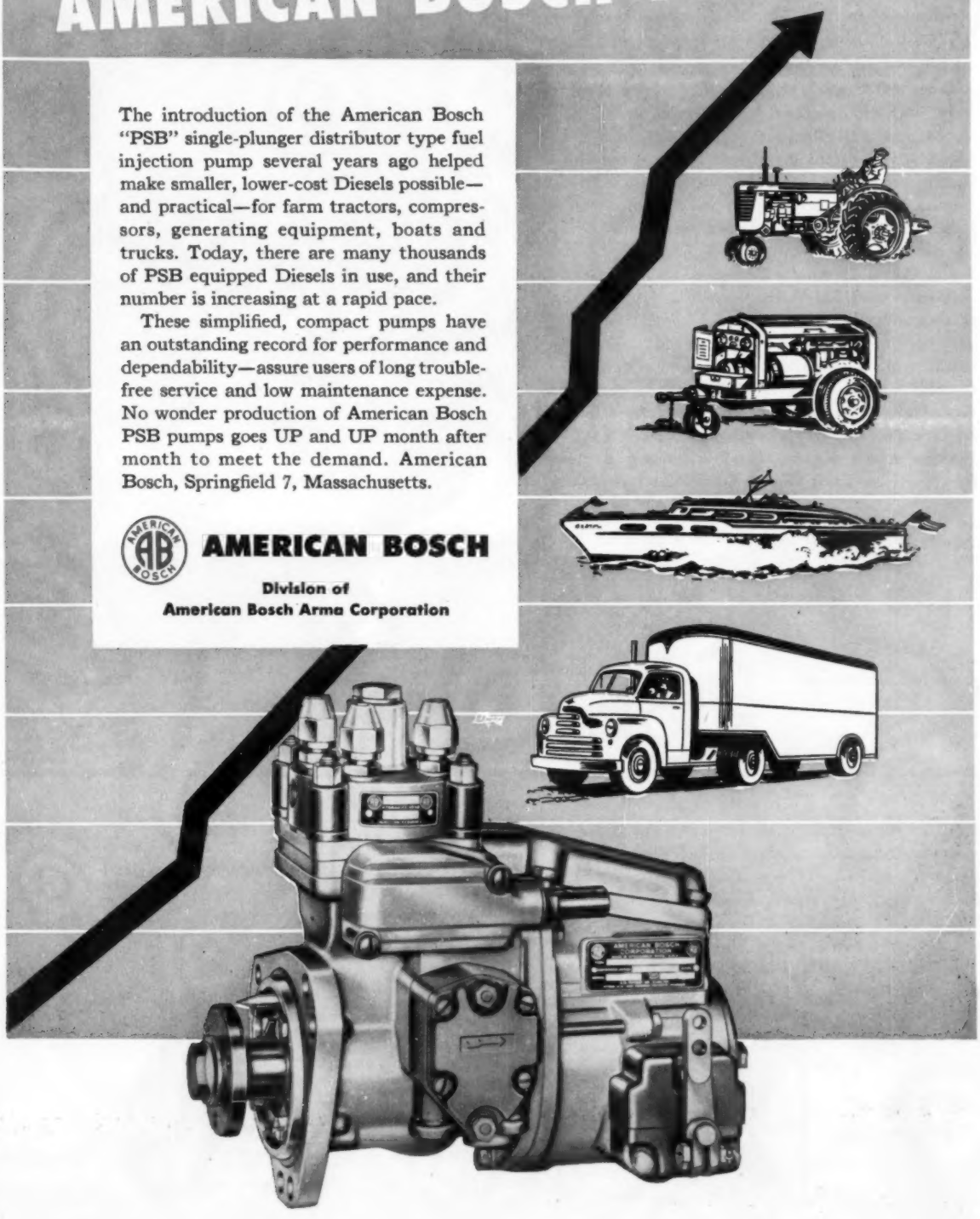
the UP and UP story on the AMERICAN BOSCH PSB!

The introduction of the American Bosch "PSB" single-plunger distributor type fuel injection pump several years ago helped make smaller, lower-cost Diesels possible—and practical—for farm tractors, compressors, generating equipment, boats and trucks. Today, there are many thousands of PSB equipped Diesels in use, and their number is increasing at a rapid pace.

These simplified, compact pumps have an outstanding record for performance and dependability—assure users of long trouble-free service and low maintenance expense. No wonder production of American Bosch PSB pumps goes UP and UP month after month to meet the demand. American Bosch, Springfield 7, Massachusetts.

AMERICAN BOSCH

Division of
American Bosch Arma Corporation



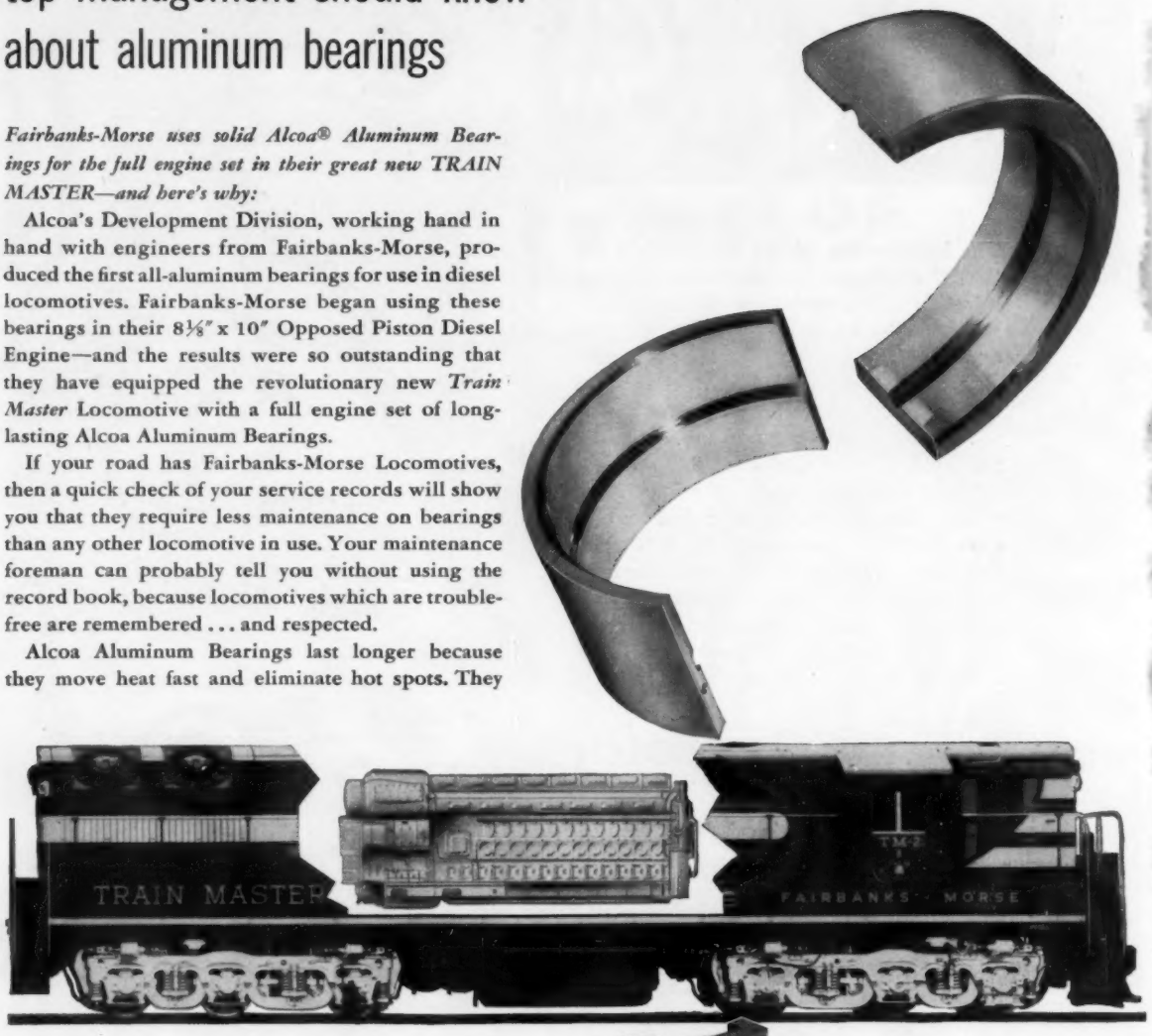
What every railroad's top management should know about aluminum bearings

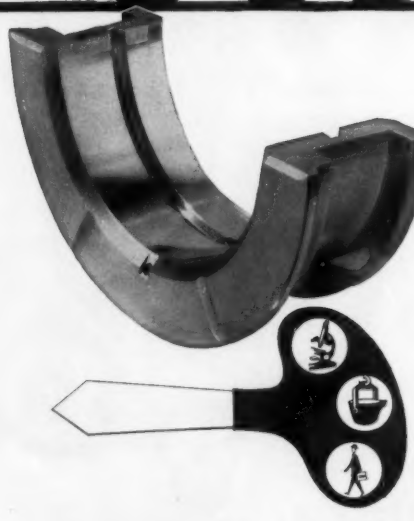
Fairbanks-Morse uses solid Alcoa® Aluminum Bearings for the full engine set in their great new TRAIN MASTER—and here's why:

Alcoa's Development Division, working hand in hand with engineers from Fairbanks-Morse, produced the first all-aluminum bearings for use in diesel locomotives. Fairbanks-Morse began using these bearings in their 8⅛" x 10" Opposed Piston Diesel Engine—and the results were so outstanding that they have equipped the revolutionary new *Train Master* Locomotive with a full engine set of long-lasting Alcoa Aluminum Bearings.

If your road has Fairbanks-Morse Locomotives, then a quick check of your service records will show you that they require less maintenance on bearings than any other locomotive in use. Your maintenance foreman can probably tell you without using the record book, because locomotives which are trouble-free are remembered . . . and respected.

Alcoa Aluminum Bearings last longer because they move heat fast and eliminate hot spots. They offer the ultimate in corrosion resistance and have extremely high load-carrying ability. They are solid bearing metal all the way through, with no hard backing to score expensive shafts—cause costly down-time. What's more, these bearings in many cases actually cost less than the bearings you're now using! Our Development Division Engineers can give you the whole story on these bearings—just write: ALUMINUM COMPANY OF AMERICA, 1988-F Alcoa Building, Mellon Square, Pittsburgh 19, Pa.



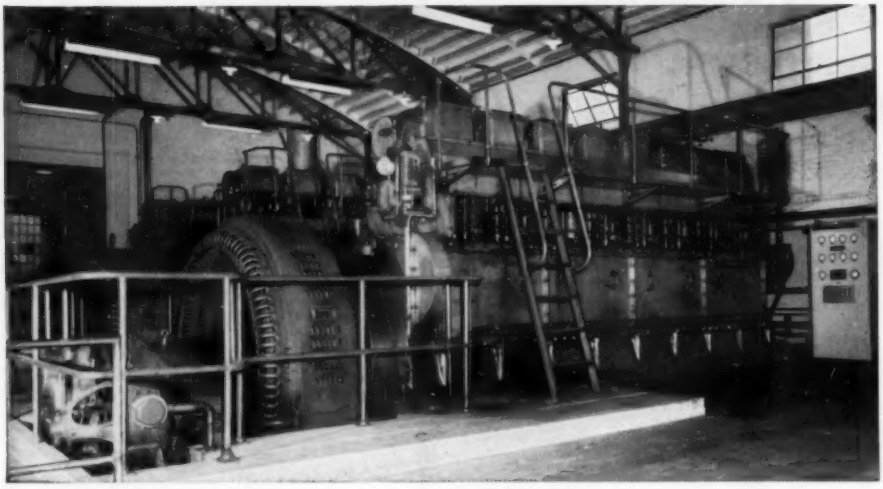


Your Guide to Aluminum Value

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Fuel oil savings, 50% longer service ... thanks to Koppers Piston Rings

... Koppers Piston Rings, Municipal Power Plant, Tarboro, N.C.



Koppers Porous Chrome* Rings. Porous chrome surface holds and distributes oil during break-in. Seats quickly. This chrome prevents grit from embedding in ring surface. Prevents cylinder wall scratching. Reduces wear 50%. Last 4 times longer than other rings.

Here's proof *that installation of Koppers Piston Rings can save on fuel, lubricating oil, labor costs.*

In conducting routine maintenance operations of the Municipal Power Plant, Tarboro, N. C., it was decided to install a new type of American Hammered Piston Ring.

Tarboro now uses #5 fuel oil (for which diesel was originally designed.) *Result: Tremendous Savings in fuel costs.*

In addition, compression has been increased . . . lubrication oil consumption decreased 200%-300%. And thanks to Koppers Piston Rings, cylinder wear has been less than .010 inches after 15 months of operation even under difficult working conditions. Think what that means in longer service, less down-time, lower labor costs.

There are many cases in which the installation of Koppers Piston Rings has proved helpful in getting economical engine performance. Does this suggest savings in operating and replacement costs to you? Then remember Koppers Piston Rings next time you have a diesel overhaul. First thing, investigate Koppers Conformable and Porous Chrome* Rings. And for special assistance with your specific piston ring problems, consult our technical staff.

Koppers Conformable Ring maintains constant unit pressure for positive oil control. Conforms readily to meet cylinder distortion because flexible cast iron member is pressed outward by abutment type spring which exerts uniform radial pressure around entire circumference.

*Van der Horst Process

KOPPERS®

AMERICAN HAMMERED
Industrial Piston Rings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • Baltimore, Maryland
This Koppers Division also supplies industry with Fast's Couplings, Aeromaster Fans, Koppers Electrostatic Precipitators and Gas Apparatus.
Engineered Products Sold with Service

KOPPERS COMPANY, INC., Piston Ring Dept., 1546 Hamburg Street, Baltimore 3, Md.
Gentlemen: Please send me full information on your Conformable Oil Ring.

Name .....

Company .....

Address .....

City ..... Zone ..... State .....

SOLVE vibration • movement • expansion problems

SIMPLIFY offset connections

REDUCE maintenance ... in diesel exhaust, air, oil and water piping

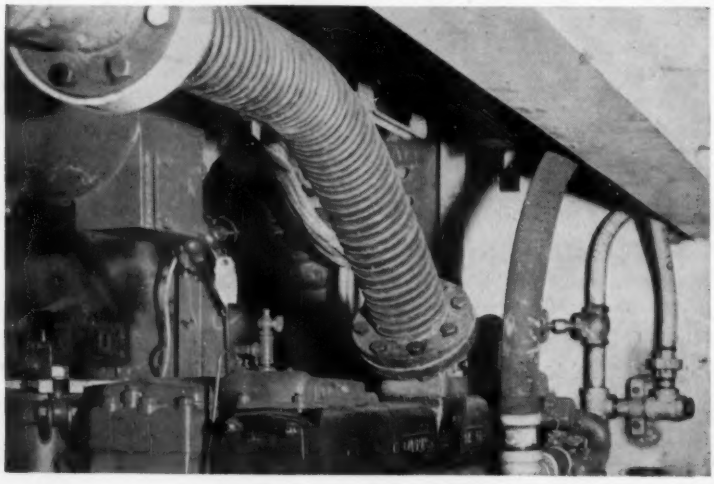
In diesel engine piping systems, American flexible metal hose offers a practical solution to problems of vibration and expansion, the principal reasons for accelerated failure of rigid pipe. It's simpler to install, too. You *bend* it into position, saving time on the job and making easy work of fitting offset connections.

For heavy-duty exhaust and air intake lines, specify American Flexible Steel Corrugated Hose. It adjusts to expansion and dampens engine vibration, preventing excessive stress on exhaust manifold flange bolts and fittings. Vibration dissipates in the hose and is not transmitted to adjacent structural members. Assemblies are supplied complete with floating flanges to simplify lining up with companion flanges.

To convey air, oil and water, use American Seamless Flexible Metal Tubing. Made in bronze or carbon steel for standard service, and in stainless steel or Monel for special service. Tubing has woven wire braid covering for added strength. Complete assemblies include fittings.

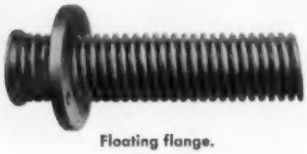
55190

Below: Flexible, corrugated steel hose carries hot diesel exhaust gases to atmosphere.



Type Y-10 flexible, corrugated exhaust hose assembly with floating flange, left, and fixed flange. ID's 2" through 16".

Type Y-10 hose with welded nipple, supplied with or without flange.



Floating flange.

Type S-1 braid-covered seamless flexible metal tubing for air, oil and water lines. Seamless tubing is 100% tight and extremely flexible. ID's ⅛" through 12". Usually furnished with fittings attached.

WANT MORE INFORMATION? Bulletin EH-50 gives detailed engineering data on American flexible metal hose and tubing for diesel engines. We'll be glad to send you a free copy, or have one of our sales engineers call. No obligation of course. Address *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.* In Canada: *The Canadian Fairbanks-Morse Company Ltd.*

WHEREVER CONNECTORS MUST MOVE

AMERICAN

FLEXIBLE METAL HOSE AND TUBING

AN

ANACONDA®

PRODUCT

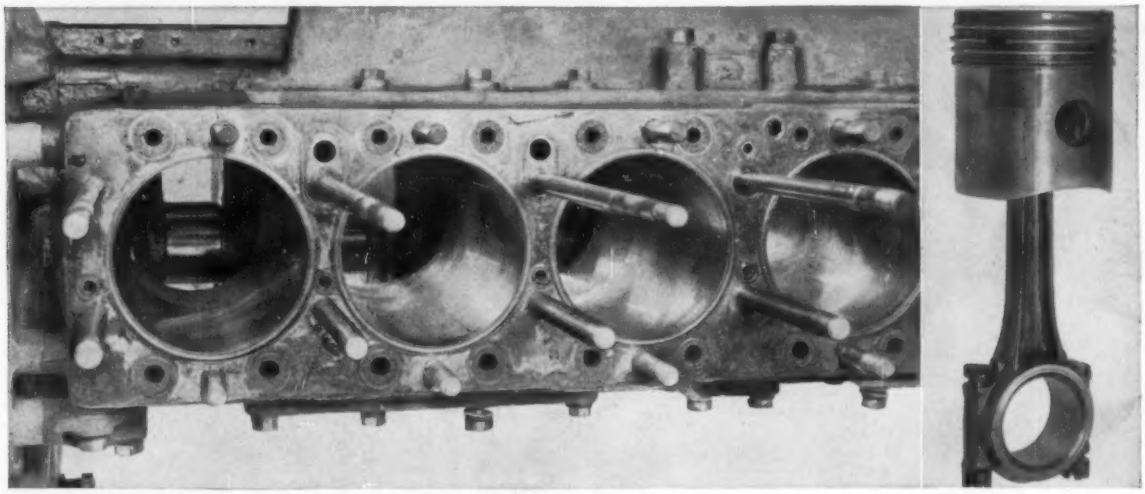
The Engineer's Report

CASE HISTORY

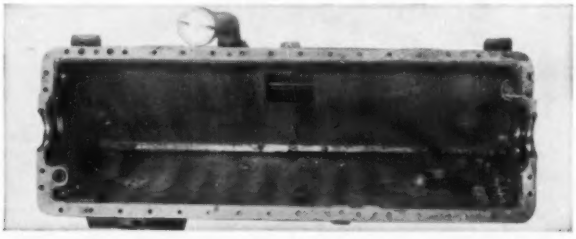
LUBRICANT RPM Delo Oils

FIRM Boise-Winnemucca Stages Inc., Boise, Idaho

Cylinder wear only 0.006″ after 228,413 miles!



USING RPM DELO SPECIAL LUBRICATING OIL, this 180-H.P. Fageol engine went 228,413 miles without repairs of any kind, in a bus owned by Boise-Winnemucca Stages, Inc. It ran in intense summer heat and sub-zero winter temperatures on the line's regular route. Wear on cylinders measured only 0.004" to 0.006" and crankshaft journals were still factory standard. All rings were free, all bearings good and pistons showed no varnish. There was no measurable wear on crankshaft or wrist pins.



REMOVED FOR FIRST TIME, oil pan shows no deposits, clean metal is visible after draining. RPM DELO Oils reduce wear and keep engines clean in all of the buses owned by Boise-Winnemucca Stages.

FREE FOLDER tells you about all the RPM DELO Oils and how they meet every heavy-duty engine condition. Write or ask for it today.

FOR MORE INFORMATION about petroleum products of any kind or the name of your distributor, write or call any of the companies listed below.

RPM DELO LUBRICATING OILS

How RPM DELO Oils reduce wear, corrosion, oxidation in all heavy-duty engines

A. Contain special additives that provide metal-adhesion qualities...protect parts whether hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring sticking. Detergent keeps parts clean...helps prevent piston scuffing.

C. Special compounds stop corrosion of any bearing metal and foaming in crankcase.

TRADEMARK "RPM DELO" REG. U.S. PAT. OFF

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • STANDARD OIL COMPANY OF TEXAS, El Paso
THE CALIFORNIA OIL COMPANY, Barber, New Jersey • THE CALIFORNIA COMPANY, Denver 1, Colorado

CUNO MICRO-KLEAN FILTERS handle entire flow of lubricating oil through Clay Electric Co-operative's Cooper-Bessemer Diesels.

How Florida electric utility knocked 25% off power production costs

We're talking about the Clay Electric Co-operative, Inc., in Keystone Heights, Florida.

In 1950, when they were burning distillate oil in their five Cooper-Bessemer Diesels, Clay's cost per kilowatt-hour was 9.914 mills. Switching to Bunker C oil in 1953 brought production costs down to 7.629 mills per kilowatt-hour. That's practically 25% in any man's language.

Our part in this success story? Cuno MICRO-KLEAN filters handle the tough job of filtering the entire flow (150 gpm) of lubricating oil through each Cooper-Bessemer. And according to Robert Dodd, Chief Engineer at Clay, the MICRO-KLEAN's are just right. Here's what he says: *"We're very pleased with the performance of the* MICRO-KLEANS. *They're very definitely assisting in making our success possible."* Mr. Dodd goes on: *"I heartily endorse your* MICRO-KLEAN *filters for lube oil service – they fully protect the engine from dirt particles. Trying to cut corners on filters can be false economy of the worst kind."* We agree, Mr. Dodd.

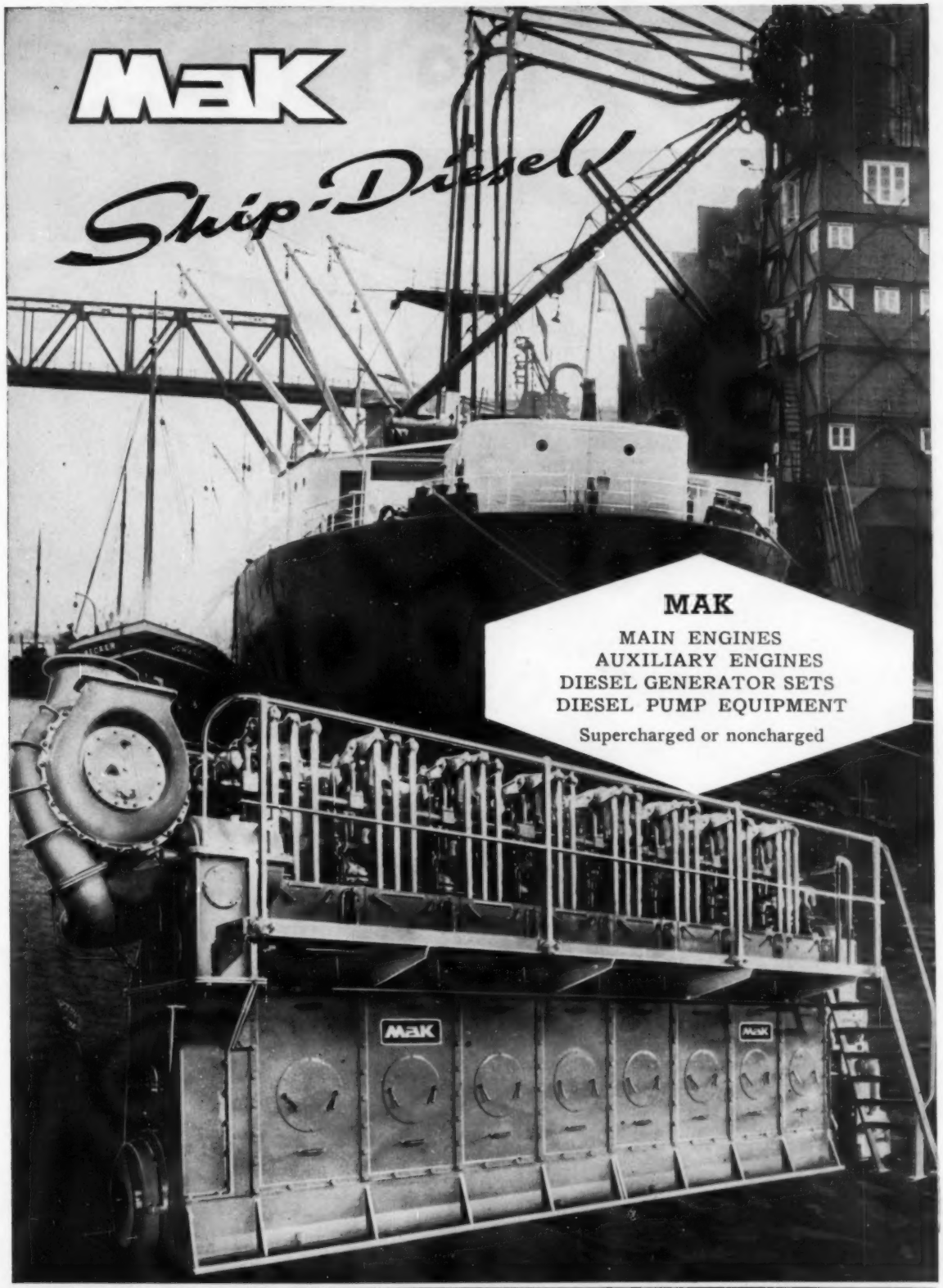
Want to know how MICRO-KLEAN can help solve *your* lube oil problem? Write us today for free MICRO-KLEAN bulletin. Cuno Engineering Corporation, Department 25, South Vine Street, Meriden, Connecticut. 4.11

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

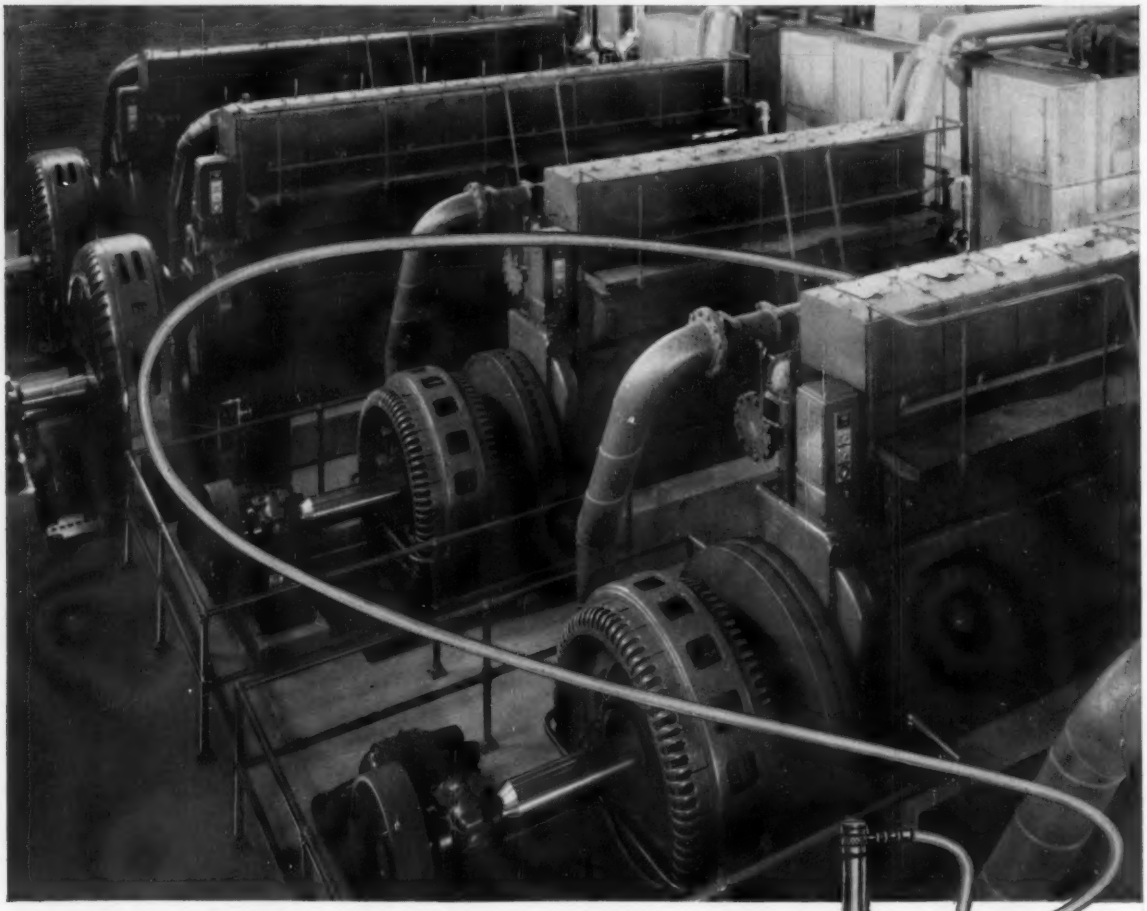
AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)



MASCHINENBAU KIEL AKTIENGESELLSCHAFT

GERMANY

Log More Hours!



Log more hours . . . the *extra* hours of peak performance you get when you switch to Sinclair RUBILENE®. RUBILENE guards diesels against sticking rings and prevents excessive wear of moving parts operating continuously for long periods. You will find that RUBILENE lubrication pays off in lowered maintenance costs and your engines log more time between overhauls.

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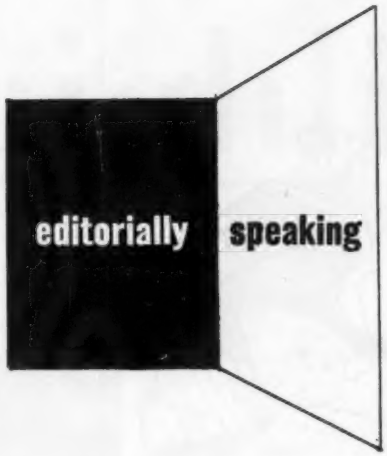

Who's Gonna Fix Them?

It begins to look as though diesel production will exceed our 1955 Outlook prediction by something like 10% to 12%. Smaller engines will account for the bulk of the increase. And we look for continuing high production for some time to come. For justification (if any is needed besides faith in our industry's products) look at just one project that's in the making—the expanded highway construction program. Some bill will go through Congress; it's a question only of how much, distribution and method of financing. It will be big; we must have adequate roads for national growth. And road building from preliminary cut-and-fill to final paving is a diesel job. For an authoritative report get a copy of the American Road Builders' Association survey entitled "The Highway Construction Industry in a Ten Year National Highway Program." Costs a dollar and is an evaluation of that industry's capability to execute a program to eliminate the estimated $101-billion highway deficiencies in a 10-yr period. A 1954 construction equipment inventory shows roughly 300,000 items (mostly diesel-powered) and phasing of additional and replacement equipment over the 10-yr period adds up to over a million units! A high usage factor is presupposed, higher than for current usage. This means more overhauls, more parts and more supplies each year. Who will do the work and supply the parts? One thing seems certain; independent shops will do a lot of this work. Surveys tell us that they are handling a good percentage now. This being the case the engine builders' self-interest calls for improved dissemination of service information. Independent parts makers are eyeing this expanding market, too. This is and will be more competition in this field which may well make re-examination of present factory parts discount structures advisable. Some one is going to fix them; the user's concept of service *must* be served. If not diesel production will not attain its potential growth.

B P E

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highlights

- During the first two months of 1955, Class I railroads installed 221 new diesel-electric locomotive units.

- The Aluminum Co. of Canada has named the S&S Machinery Co., 140 53rd St., Brooklyn, N. Y., to manage the sales of $24 million worth of construction equipment used during the construction of the Kitimat hydro-electric and aluminum smelter project in British Columbia.

- Machinery and Allied Products Institute tells us that the importance of the Latin American Market is growing. During 1954, Latin America absorbed more U.S. capital goods than any other major market.

- B. Brewster Jennings, president of Socony-Vacuum Oil Co., has predicted that oil will be used in much greater volume in the future even though other sources of power come into use, according to a detailed analysis of petroleum industry trends and prospects.

- Iowa State College has announced it will hold its sixth Diesel Power Plant Conference from July 18th to 20th, 1955. The program has been planned around suggestions made by operators who have attended previous conferences.

- During 1954, according to the Association of American Railroads, Class I railroads spent $307,772,000 for diesel fuel oil. This was an increase of $7,553,000 compared with 1953. On the other hand, expenditures for bituminous and anthracite coal declined from $148,774,000 in 1953 to $81,013,000 in 1954.

- Announcement has been made that the Chicago Exposition of Power and Mechanical Engineering will be held in the Chicago Coliseum, November 14th to 18th, under the auspices of the American Society of Mechanical Engineers and in conjunction with their 75th anniversary meeting.

- Passenger train miles handled by diesel-electric locomotives by Union Pacific during 1954 increased to 73.3% from 62.3% in 1953.

- Worthington Corporation has been awarded a contract to supply La Porte City, Iowa, with an 840-kw, dual-fuel engine.

- June 20 to 23, 1955 is the date for the semi-annual meeting of the American Society of Mechanical Engineers. It will be held at the Hotel Statler in Boston, Mass.

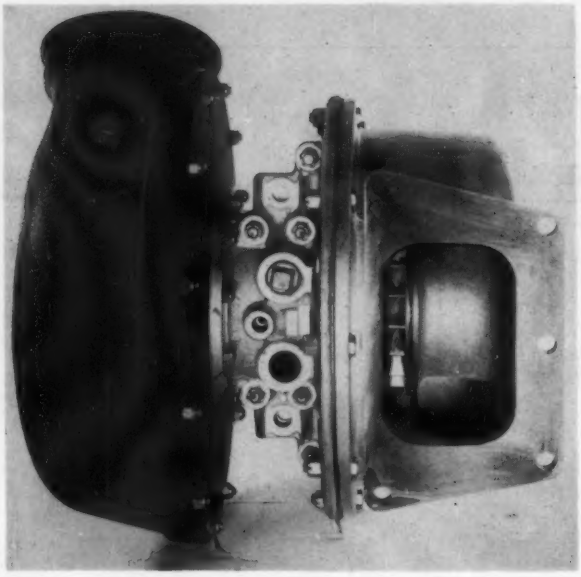
- Canadian National Railways and its subsidiaries currently operate a total of 580 diesel-electric locomotives in Canada and there are more on the way.

- Southern California Edison has been issued a license by the FPC for a proposed hydroelectric project in Fresno County, California. Another job for diesel-powered construction equipment. Known as the "Portal Project", it will include a 60-ft high rolled earth dam.

- In another decade, forecasters say, 67 million passenger cars and 14 million trucks and buses will be using the highways. This will mean more and better roads than we have at present and also more diesel-powered equipment to build and maintain them.

- Ever wonder what happens to apricot pits? They are used, among other things, to clean traction motor armature cores.

- If one year's production of diesel fuel injectors made by the Diesel Equipment Division of General Motors were operated in engines continuously for one year, they would inject more than 5½ billion gal (5,571,500,000) of fuel oil. During this time the engines would develop about 77½ billion hp. If this energy could be stored in your car and used to drive it at 60 mph, it would take you around the world 2,058,000 times and it would require 97,900 years.



AiResearch's small, compact turbocharger now on new Caterpillar D9 tractor. Turbine is at right (part of turbine wheel is visible), with compressor at left. Rotor shaft is centrally supported.

Approximate position of tractor mounting. Turbine exhaust in foreground. Inlet flange bolts directly to exhaust, supports unit. No water cooling and use of engine oil simplifies installation.

Turbochargers Enter New Fields

*By Dr.-Eng. W. T. von der Nuell**

Small engine turbocharging can mean economic and operational advantages to you. This timely and important field is reviewed and a newly-introduced turbocharger described.

MANY, if not most, of the big diesel engines in stationary powerplants, ships and also locomotives built in the last decade owe much of their good economy record to the improvement of the work-cycle through turbocharging.

No similar statement could be made for the small diesels, say from 100 to 400 hp, millions of which power trucks, buses and tractors as well as pumping stations, generator sets, etc. This gigantic field is being "conquered" by the turbocharger at present. Some thoughts regarding the "why" and "how" may interest both users and manufacturers and help overcome prejudice or rejection which may have been justifiable in the past. Of course, here, like with all new commercial products, the relationship between technical progress and economical benefit influences the acceptance by the market. i.e. the user.

Although this is not the place to reflect on the impulse given to accelerated development by the armament requirements in a war, one must not ignore the fact that the demand for faster and heavier airplanes cruising at greatly increased altitudes resulted in production of turbochargers in unprecedented numbers. Despite the fact that from an engineering point of view their efficiency was rather moderate, they did well for the purpose intended.

Experience gained in decades of steam-turbine and turbo-compressor building and operating was their benefactor and godfather; still, they caused their creators many sleepless nights. Why? It lies in the nature of the beast "small turbomachine" to prove increasingly difficult with decreasing dimensions whenever high performance, both in regard to efficiency and mechanical integrity, are to be obtained.

These aircraft turbochargers operated with air and gas flow rates of, say, several pounds per second and moderate pressure ratios. Yet, compared to the requirements of the 100- to 300-hp 4-cycle diesel engines, they were rather fortunate. Take a 150-hp truck diesel. It only needs about one half pound of combustion air per second and, when turbocharged, wants this air's density increased by at least 25%, or precompressed 1.5 or so to 1. before swallowing it through the intake valves. After having digested air and fuel and extracted the normal portion of energy, our diesel discharges the exhaust gas at a temperature higher than comfortable for

** Asst. Chief Engineer, heading Engineering of The Garrett Corporation's New "AiResearch Industrial Division".*

most materials at, say, roughly 1100°F or more. There, you have the truck turbocharger problem in a nut shell.

For the most widely used tractor engines, the flow rates, temperatures, etc., are similar. Additional problems must be solved, however, in view of the rough and tough operation common with big bulldozers. Just imagine a piece of precision machinery revolving in a 1000°F gas stream at top speeds of around 1000 fps. Or, to express it more simply, at rotational speeds of 35,000 to 50,000 rpm and exposed pitilessly to the jolts of the dozer removing a tree or rock with brute force!

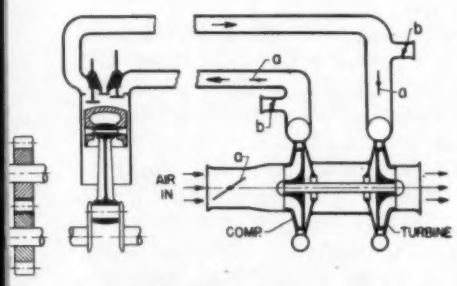
Not only does this sound like a genuine challenge, but certainly it required consolidated efforts to master the task. Nevertheless, it can now be reported that the machinery has been perfected to such a degree as to permit offering of turbocharged tractors to the earth-moving industry. Caterpillar's huge D9, a 28-ton track-type tractor with a 6¼-in by 8-in, 6-cyl diesel having an AiResearch turbocharger, is in production.

The AiResearch Turbocharger T15, now in sizable production, covers through-flow rates from approximately 25 to 65 lb of air per minute at rated pressure ratios up to 2:1 which, due to the high compressor efficiency, represents a density ratio (engine air to ambient air) up to 1.5. Its bigger companion, T30, handles up to 110 lb of air and, even though only somewhat bigger, has demonstrated an over-all efficiency, including all compressor, turbine and mechanical losses, of 62% to 64% when tested on a standard diesel engine.

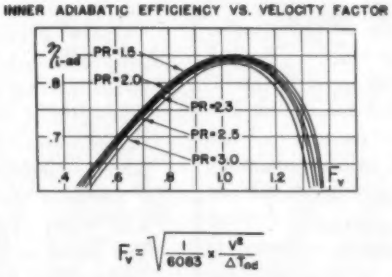
Before proceeding with the more detailed description of these units, let us brief the available field records.

Based on some component testing, a few experimental turbochargers were built and underwent thorough performance and extensive endurance testing both at AiResearch and Caterpillar's laboratories. The second unit built was installed in a track-type tractor which within ten months of earth moving accumulated over 1800 hours of operation without trouble. Shortly thereafter, two more went into field service which then also included operation in rubber-tired vehicles.

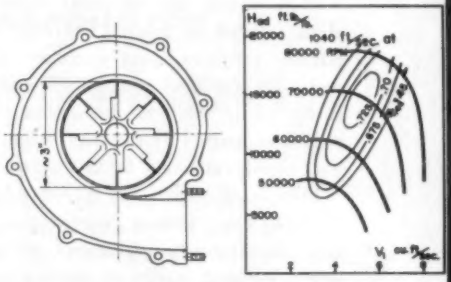
Another early unit went into operation on a diesel engine driving a large oil pump. At this moment, it has accumulated more than 5500 hours of fairly high load operation without requiring maintenance and without showing signs of deterioration. With some very minor changes, a few dozen preproduction turbos were placed in field duty. Within a period of less than one year preceding this writing, over 20,000 hours were accumulated in actual earth moving and similar field operation and an additional 12,000 hours in continued laboratory endurance testing without observing any serious difficulty.



Centripetal turbines with 5- to 10-in wheel diam were developed by AiResearch with efficiencies quite comparable to large turbines. Plot shows performance for pressure ratios from 1.5 to 3 in a simple single-stage unit.



In 1944, the author engaged in development of very small and simple turbochargers. Shown is the compressor and its performance chart of a unit matched to the then-common passenger car engines in the 75-hp range.



Scheme of turbocharged reciprocating internal combustion engine. Depending on the application, throttling can be provided at points marked "a", or bypassing at points marked "b" for required system control.

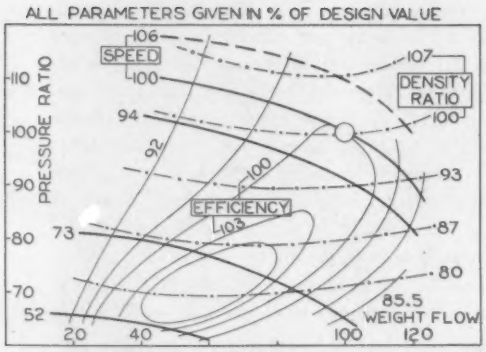
Background

The Garrett Corporation's AiResearch divisions have specialized in a great number of various small turbomachines for aircraft and ground equipment during the past ten years. These products include miniature refrigeration turbines, cabin superchargers, gas turbines and air- and gas-turbine motors. Over 25 million hours of field operation with their products represent an experience and proof of success probably not equalled in this field. Turbine wheel top speeds of over 1550 fps and gas temperatures of 1550°F are routine working conditions for AiResearch gas turbines. Turbocompressors with impellers of just a few inches in diameter, pressure ratios over 2:1 and adiabatic efficiencies of 80% + represent unquestionable proof that the "beast" has been tamed or, to express it more factually, that engineering and manufacturing have recognized what makes a small turbomachine of high performance and mechanical integrity a reliable piece of desirable equipment.

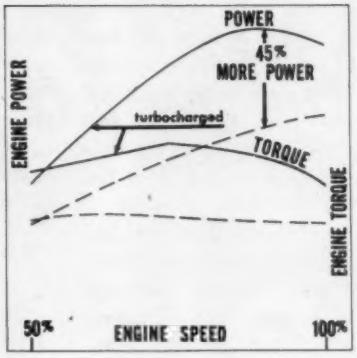
With this background, the branching out into the turbocharger field has its proper perspective.

Description

Essentially, these AiResearch turbochargers contain a compressor with a fully-shrouded backward-curved type impeller followed by a vaneless diffuser and a 360-deg volute or a semi-constant area torus. The 90-deg type radial turbine wheel is surrounded by a very simple nozzle ring with straight vanes that are exchangeable for purposes of adaptation to different engine ratings.



Pressure ratios vs. through-flow are plotted with lines of speed, efficiency and density ratio constant. As seen, only minor change in turbo rpm is required over a through-flow range of 2:1 to maintain constant density ratio.



Performance data measured on first application of turbocharger to a tractor's diesel engine. Note power increase and torque characteristic improvement.

Compressor torus and turbine housing are attached to the center housing of the unit. This center housing contains the rotating group in its bearing carrier and provisions to stop oil entering compressor and turbine.

Both wheels are mounted overhung on a common shaft rotation in journal bearings, one of which incorporates thrust-carrying surfaces. To ascertain smooth and safe operation, the rotor's critical speed is significantly higher than the maximum rated speed. The T15 unit is supported by the inlet flange of the turbine housing, rigidly attached to the engine's exhaust manifold.

Like in all high speed turbomachinery developed and built by the Garrett Corporation, the critical components of the turbochargers are always subjected to severe strength testing in whirl pits. Additionally, these turbochargers have been tested for hundreds of hours with mechanical stresses 25% higher than at maximum rating and, at the same time, with gas temperatures a good 100°F above those encountered at maximum diesel engine loads without showing signs of distress.

Some turbochargers offered in the past have had their own independent oil supply system or have required special provisions for lubrication. Not so with the AiResearch turbos which use oil tapped directly from the engine. Furthermore, these turbochargers have no water-cooling whatsoever because they need none and doing well without it, offer another simplification.

While speaking about simplicity, so essential for reliability and economy reasons, it should be pointed out that the turbocharger system employed on the Caterpillar tractors is of the free-floating type, i.e. no controls or valves for bypassing, cross-bleeding or throttling are used. All engine exhaust gas passes through the turbine, all air compressed in the turbo flows into the engine's cylinders. This arrangement requires sufficiently broad operating characteristics at maintained good efficiency in both compressor and turbine and without occurrence of pulsation in the compressor. Also, for satisfactory acceleration of the entire powerplant and, thus, for the vehicle, a low moment of inertia of the turbo's rotor is essential. And for all these reasons AiResearch turbochargers have simple radial rotational components.

Why Turbocharge?

Conceivably, the diesel engineer might ask now, how much power increase and improvement in fuel economy can he count on when adding a turbocharger to his engine? To begin with, such answer depends firstly on the capability of the engine itself and, secondly, on the quality or, better expressed, efficiency and flexibility of the turbocharger used.

In the original application of AiResearch's first experimental turbo to a 1250-cu in heavy duty diesel, 45% power increase at 85% engine speed and a welcome improvement of the torque curve were most easily demonstrated. Meanwhile, in testing with more boost, greater power augmentation of engine output was effected.

Stressing the efficiency of the turbocharger in this way might appear like overdoing it. Not so! In the first place, no engine is fond of too hot an air charge. Temperature rise in the air through compressing to a given value is the smaller, the higher the efficiency of the compressor. Moreover, to produce a certain increase of air density—and this is the main purpose of turbocharging—requires less turbine power if the compressor efficiency is high. Less turbine power means less turbine inlet pressure, i.e. cylinder back pressure.

Since, generally, it is most desirable if not vital, to maintain a ratio of boost pressure to back pressure above unity over as wide an engine load-speed range as possible, the diesel engine is truly appreciative of high turbocharger efficiency. Its duty becomes more easy; its aches and pains from heat or bad combustion are nicely reduced in spite of yielding more power per unit displacement. Needless to say that overhaul and maintenance records reflect these facts, often doubted, yet more often proven by now.

One other effect on noise since the turbine suppresses the "barking" to a remarkable degree. The weight and size savings obtained by turbocharging hardly need much explaining. For a British turbocharged vehicle engine, it was recently stated that if said engine would have been "built to produce 200 hp with the same power-to-weight ratio, its weight would have been increased by more than 800 lbs".

Looking Ahead

Now, then, how far can a turbocharger "boost" a

diesel engine and what does the future hold in terms of economical aspects? A well developed simple turbocharger of the single-stage type and of the high standard now established in small gas turbines can easily increase the density of ambient air by a factor of 2 or more. When applying such a turbocharger to an engine it can double or more than double the power output which this diesel, operating self-aspirating, could produce.

By using a cooler to reduce the temperature of the compressed air prior to its admittance to the engine cylinder, the density ratio between ambient air and engine charge air can become higher than 3. This can result in something like triple the power output provided the engine itself was developed to stand this loading.

Fortunately, a well developed turbocharger of given specifications has the inherent capability of serving all common 4-cycle diesel engines of comparable characteristics as long as they have approximately the same air flow requirements (products of displacement times span) and allow for approximately the same degree of turbocharging. Let us explain this a little further.

At present, a good number of vehicle-propelling diesel engines of the smaller size produce an average of 1 hp per 5 cu in piston displacement. These engines have, within a sufficiently narrow range, about the same combustion airflow requirements, i.e. product of displacement and rpm. Thus, one good turbocharger model could serve all these engines equally well. Evidently, this fact is of economic significance, in that, once accepted on a large scale, the ensuing production quantity can only result in low cost compatible with the engines they improve. Additionally, by offering a reduction in specific fuel consumption of say 20% or better, the cost added to the diesel engine by equipping it with a turbocharger is regained more or less automatically.

There are strong indications that all these facts and possibilities are now finding wide recognition. Lately, nearly all manufacturers of vehicular diesel engines offer one or more of their models with turbochargers. Accordingly, the number of manufacturers of turbochargers has increased; further announcements of newcomers in this field can be expected.

And where are we going from here? Well, two facts are evident. Great efforts are being extended in the field of turbocharging 2-cycle diesel engines of sizes and for applications not previously so developed. Let it suffice to say here that this task is of a somewhat different nature in that here the turbochargers may have to be more closely tailored to the various engines. Secondly and speaking quite generally, higher boost pressures will necessitate intercoolers to reduce the temperature of the charge air to acceptable values and simultaneously increase its density. Turbochargers may become somewhat bigger, relatively speaking; for some applications, higher exhaust temperatures may have to be dealt with.

One prediction appears fairly safe: the turbocharged diesel engine will represent a tough and hard-to-beat competitor for other prime movers sometimes assumed to be just around the corner.

Cat Introduces...

The D-9

Sixth member of the Caterpillar track-type family, the D-9 is powered by a 286-hp, turbocharged diesel.

RESEARCH for a bigger tractor doesn't have any real beginning. Not unless you back beyond that Thanksgiving Day in 1904 when Ben Holt first tried tracks on a steamer, down in California's San Joaquin country. There has always been a demand for more horsepower.

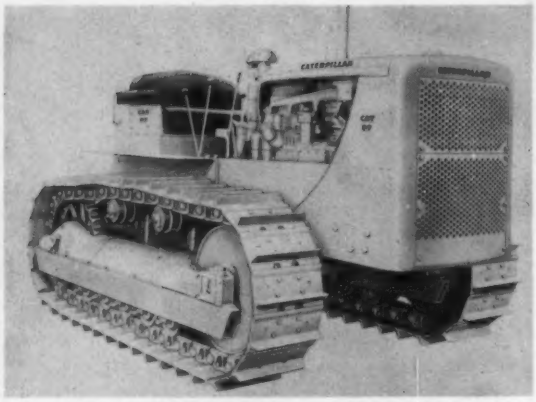
The D-9 is designed to meet that demand with a drawbar horsepower of 230, developed by its 6¼-in bore by 8-in stroke, 6-cyl diesel. Horsepower developed at the flywheel of the 4-cycle, turbocharged engine in 286. Piston displacement is 1473 cu in.

There is a 6-v electric starter for the 3-cyl starting engine. The diesel which delivers its 286 hp at 1200 rpm for both the torque converter and direct drive models, shows considerable attention to external appearance. Oil lines, fuel lines and water tubes are placed internally as much as possible.

Several features of the engine include: short valve push rods, which are possible because the camshaft is high in the block; stationary oil jets provide a continuous stream of oil to cool the pistons, the camshaft and followers; and steel-backed aluminum bearings with the lower half of the center main bearing to take the camshaft thrust on a flange-type bearing.

All accessories are driven from a gear at the rear of the crankshaft to avoid much torsional vibration. There

more



Cat's D-7 tractor has been modified in many ways including a boost in horsepower and speed. Much thought is also being given to modifications which will make maintenance an easier job.

is constant power drive for rear-mounted equipment, such as cable controls, providing power regardless of whether the flywheel clutch is engaged or when the torque converter is operating at lowest speeds.

Pressure lubrication and full flow filtration are provided in the engine, the transmission, steering clutch release booster and each final drive. Pressure lubrication is provided also for the oil clutch and starting engine.

The torque converter is a three-stage, 5:1 torque multiplication unit using diesel fuel for the hydraulic fluid. The flywheel clutch used with the torque converter is a 19-in single-plate, dry-type. Torque converter fluid cooling is provided by a water-type heat exchanger mounted on the right hand side of the engine. Speeds up to 7.8 mph. With the direct drive transmission, drawbar pounds pull of 60,860-lb are possible with adequate weight traction.

Welded fabrication of the steering clutch case and main frame provides a rugged backbone for the entire tractor assembly which fits in with the severe service to which this machine will be subjected. A one-piece welded track roller frame includes closed oil-type recoil spring housing and track guiding guards at each end of the frame. The equalizer bar rests on moulded rubber pads on the track roller frame. Heavy-duty radiator guard and half-inch thick fenders are standard equipment.

The conventional drive D9 will weigh 56,200-lb and the torque converter model, 56,650-lb. The seven-roller track frame insures great flotation and stability. The one-man seat has sponge rubber cushions and is adjustable fore, aft, and vertical. Oil clutch, steering clutches and brakes are power assisted for ease of operation.

Safety was considered throughout. There are locks on both brake pedals. Pumps are mounted on the rear of the engine to provide constant power for hydraulic actuation of brake and clutch boosters. Grab irons are mounted on the rear and sides of the fuel tank for boarding the tractor and another is on the left radiator guard for servicing the air cleaner.

The deck has been cleared of all but the most essential controls and those are placed for maximum efficiency. The bulldozer cable tube for the rear cable control unit is incorporated in the right hand main frame member for safety and appearance.

Many service conveniences have been built into the D9. The hydraulic track adjuster requires only a grease gun to operate. The steering clutch and brake drum assemblies can be removed separately without disturbing the bevel gear. The flywheel clutch assembly or the torque converter unit can be removed without disturbing the engine or the transmission.

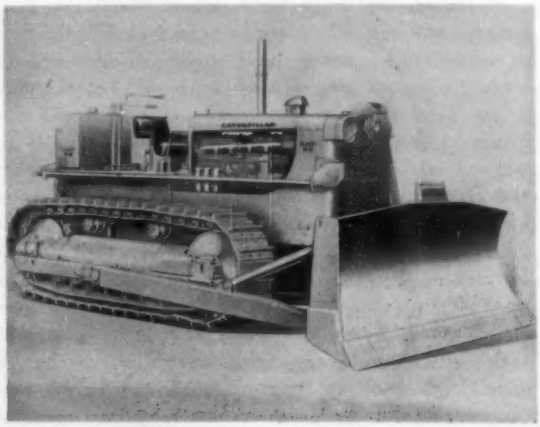
The transmission barrel assembly can be removed without disturbing the flywheel clutch. Brakes and steering clutches can be adjusted through easily removed top covers in the steering clutch housing. Brake band assemblies can be replaced without removing the fuel tank assembly. Removal of the engine from the tractor can be accomplished without disconnecting the gauge lines and starting engine controls, since the gauge panel is mounted on the engine.

In addition to the new D-9, Caterpillar has improved the D-7 and D-8 tractors. Output of the D-7 has been increased to 128 hp at 1200 rpm as compared to 108 hp at 1000 rpm for the older models. Maximum drawbar pull of the D-7 is now 28,700 lb or 3500-lb pull more than its predecessor. Other major features include a redesigned engine block, modified injection system, improved air cleaner, new starting engine and a few other changes.

The D-8 is now being offered in two models. Each has a different drive. The Series E is direct drive and the Series D, through a torque converter. Fuel tank capacity for the D-8 has been increased to 118 gal, making it possible to work a full 12-hr shift on most jobs without stopping to refuel.

The Series E retains the oil-type clutch and the Series D incorporates a single-plate dry clutch, adapted to the torque converter.

Two models of the D-8 are now being offered by Caterpillar. These are the Series E, direct drive, and the Series D which incorporates a torque converter.



Safety Control With Unique Features

Multi-point temperature monitoring with single trip unit, flexibility of application, and a unique method of actuation are practical advantages.

AN over-center type trip or control unit, a wax-element type temperature sensing unit, and some standard copper tubing are the components of Amot Control Corporation's new safety controls. The trip unit shuts the engine down by cutting off the fuel supply when things go wrong. Its over-center mechanism is manually held in the open-valve position while starting, until lube oil pressure builds up and takes over.

Obviously, any condition resulting in oil pressure below the unit's preset trip limit will stop the engine. By a unique design feature this condition is produced by high water temperature as well as lube oil system irregularities.

The characteristic of solid-expanding wax-type temperature sensing elements to produce mechanical motion in proportion to temperature change is used to trip the control unit when water temperatures exceed the preset limit. Here's how it works.

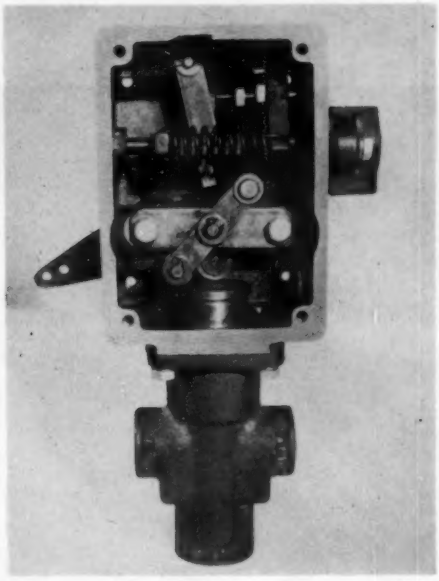
The engine's pressurized lube oil is piped to the control unit where, acting on a piston, it holds the linkage in the over-center position. Oil flow into the chamber is restricted by an orifice. Copper tubing connects the chamber with the temperature sensing unit where oil flow is normally blocked by a valve.

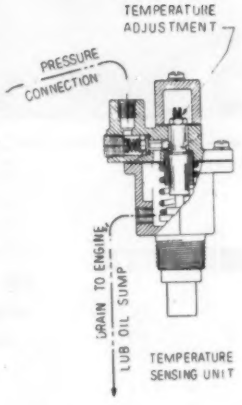
Should water temperature exceed the desired limit, linear movement produced by the wax element opens the valve. Oil bleeds to the engine's sump faster than it can be replaced (orifice limits flow). Pressure drops off and the control unit trips, shutting down the engine.

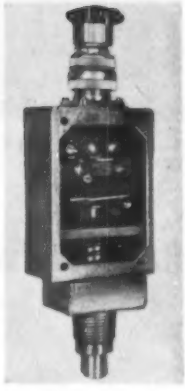
Multi-point temperature sensing with a single control unit is possible. Copper piping is used to transmit oil pressure to each one. Any unit lowering oil pressure will shut the engine down. Broad calibrating ranges of all components gives maximum applicational flexibility.

Used with gas engines, the control unit's shutdown valve supplies air to hold a diaphragm valve in the gas supply open when things are normal. Any irregularity trips the safety control, shutting off the air, venting the diaphragm valve, and shutting off the gas supply.

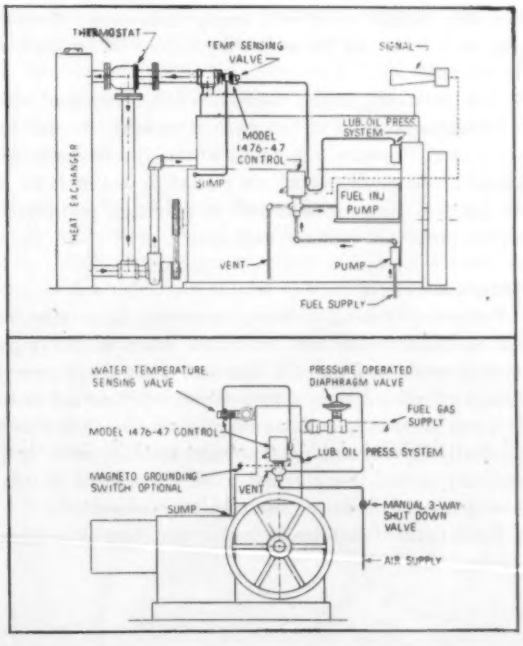
A series of temperature switches, using the wax-type sensing elements for operation of microswitches, are also available for actuating alarms, grounding single and dual magnetos, etc. Lacking the oil-bleed feature, these are used independently.







Linkage arrangement in safety control (top). Oil pressure connection is at right, 3-way fuel valve at bottom. Cutaway shows how element movement unseats ball valve, bleeding off oil. Temperature microswitch unit is at right. Typical hookups for diesel and gas engines below.



Diesel piston in cylinder showing corrosion of piston head attributed to Vanadium Pentoxide.

Residual Fuel Oil Improvers

By R. S. NORRIS, Fuels & Lubricants Consultant

MUCH has been written about heavy fuels and their use in diesels and gas turbines. The very fact that hundreds of engines and a number of gas turbines are operating satisfactorily with heavy fuels attests the fact that such fuels can be and will continue to be used in those units.

New problems present themselves frequently, and what is a serious problem in one type of diesel is not serious to another. However, regardless of the differences in the nature of the problems, all are related to one or more of the harmful compounds present in the fuels, particularly sulfur, vanadium, sodium, and water.

Nature of Fuels

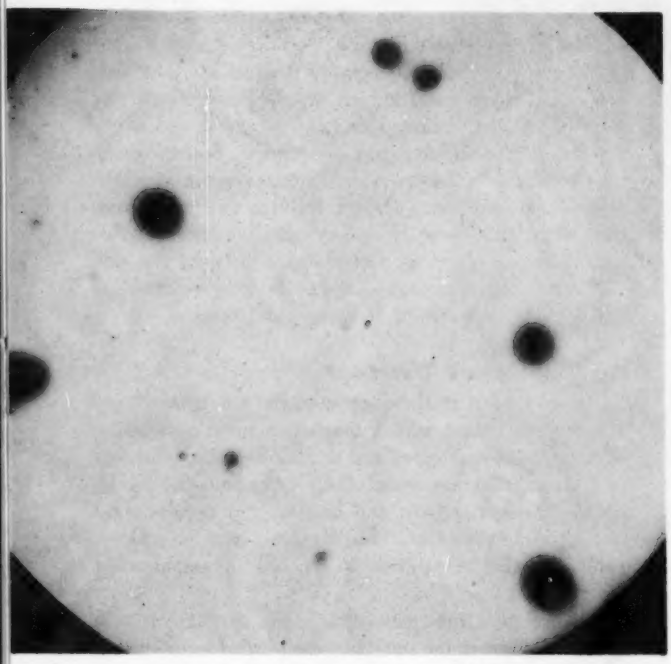
Today's petroleum refining processes have changed due to industry's efforts to obtain more of the high-revenue products from each barrel of crude oil processed. "Cat-cracked" stocks is a term commonly referred to today, and often in an unfavorable light inferring instability, sludge formation, poor storage stability, etc. It is generally agreed that thermal-cracked distillates do tend toward instability during extended storage periods.

This is true of gasoline as well as distillate diesel fuels. It was of course recognized at an early date in gasolines, all of which now contain additives to inhibit against the formation of gum and unstable polymers. More recently, additives have been introduced into domestic distillate fuel oils to prevent filter screen blocking at the burner. This was made necessary, in part, due to the unsaturates present in cracked distillate fuels.

In the case of distillate diesel fuels, the maximum percentage of cracked fuel is controlled by a specification for minimum cetane value, assuming the specification also prohibits the use of cetane number improvers. With cetane improvers, it is possible to blend in a percentage of cracked distillates.

Contrary to popular belief, the residual stocks, as such, do not originate from the catalytic cracking process, and are not necessarily any worse products than those from thermal cracking or even straight-run distillation. In all cases the crude is topped to produce the normal light straight-run distillate products, a vacuum distillate about the viscosity of a heavy lubricating oil, and a viscous straight-run residue (the truly residual fuel oil).

Catalytic cracking of the vacuum distillate portion



Electron micrograph (6000X) of No. 5 fuel treated with 500 ppm BARSAD showing dispersion. Larger particles, (maximum size 2 microns) from additive, provide anti-wear benefits and counteract vanadium pentoxide.

Electron micrograph at 6000X magnification of untreated No. 5 fuel showing agglomeration.

Sulfur, Vanadium, sodium, and water in residual fuels are known troublemakers. Removal is impractical so the best remedy appears to be the use of additives. A new additive promises to neutralize effectively their harmful effects.

produces gasoline fractions and a certain amount of so-called "cycle" oil. This is an aromatic distillate about the same viscosity as diesel fuel, but very low in cetane value. Even though low in cetane value, however, it is an excellent blending stock, to reduce viscosity of the residual stocks, and as a stabilizer for those stocks having high asphaltine content. If such a "cycle" oil were used with all heavy fuels, they would be stable and form little if any sludge in storage tanks, the double bottom tanks aboard ship, lines, heaters, etc.

In this connection it might be well to review the requirements for passing the U. S. Navy Special Fuel Oil tests. The U. S. Navy Department has long recognized the importance of compatibility between the residual portion and the distillate used to reduce the viscosity of boiler fuel oil for steam powered vessels, and specification MIL-F-895A requires compliance with tests for thermal stability and compatibility. Many of the fuels now being used in marine diesels fall within the viscosity range of the Navy Special Fuel, but may or may not meet the requirements for thermal stability and compatibility.

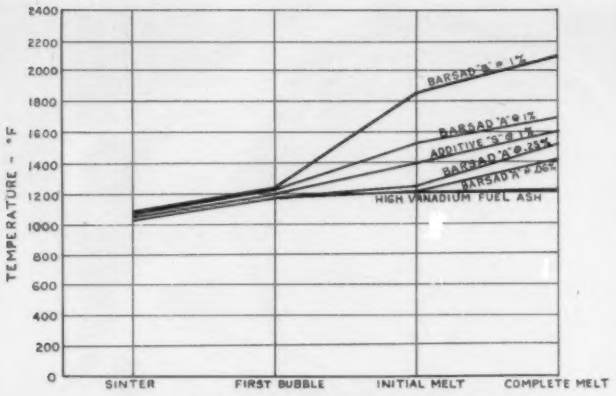
In order to satisfactorily pass the thermal stability test requires that the fuel be heated to 200°F. for 20 hours under the prescribed conditions in the heater, and shall not deposit in preheaters other than a clean, thin oil film. An unstable oil is identified by the presence of an asphaltic smear or emulsion layer.

The compatibility test consists of subjecting to the above thermal stability test a blend of equal volumes of the test fuel with approved reference fuels, and as above, shall not form deposits.

Harmful Compounds Present

It was mentioned that many problems of burning heavy fuels in both gas turbines and diesel engines are due to the sulfur, vanadium sodium, and water present in varying quantities and combinations. The bad effects of sulfur in diesel fuels has been recognized for many years. Engine builders and oil suppliers have stipulated that S-1 or S-2 (Supplemental Lists 1 and 2) types of lubricating oils be used in an attempt to counteract the high rates of wear attributed to fuels with even as much as 1% sulfur.

By comparison, these distillate fuels with 1% sulfur might be considered good in contrast to many of the



Effect of BARSAD in raising melting point of 375 ppm vanadium in fuel ash, (in micro-fusion apparatus) thereby preventing formation of V_2O_5.

residual fuels which may contain 3% to 3½% sulfur. Even the S-2 type lubricating oils do not appreciably reduce cylinder and ring wear rates when such fuels are used in diesel engines. To effectively reduce this wear by a cylinder lubricant, would require it to contain 100% additive content, which of course is not practical.

Furthermore, other parts than cylinders and rings, such as valves, piston heads, and flame rings, are subject to corrosion by sulfur in combination with other compounds. Such parts are never in contact with the cylinder lubricant. This corrosion effect is discussed in more detail later.

Vanadium as the pent-oxide, and sodium, as the sulfate, have been recognized in recent years as harmful compounds present in all residual fuels, but in varying degrees. The gas turbine industry has done a great deal of research work in studying the catastrophic effects of vanadium and sodium compounds on nozzles and rotor buckets in a gas turbine.

Much valuable data has been presented on this subject in recent papers presented at the American Society of Mechanical Engineer 1954 Annual Meeting in New York City. It is interesting to note that all authors agree that effective additives are required to counteract the corrosive effects of the vanadium and sodium compounds.

The Problems Involved

Vanadium is present in crude petroleum in an oil-soluble form, and in the distillation process of refining, becomes concentrated in the heavier fractions, although there is evidence that some vanadium is carried over into distillate fuels as well. Being oil-soluble, vanadium is not removed by centrifuging, nor is the sulfur or the sodium to any extent.

Vanadium pent-oxide is not soluble in water and cannot therefore be removed by water washing. Sodium compounds, on the other hand, are quite soluble in water, and in fact, the sodium content of the fuel ash is determined by the salt water content of the fuel. Since many residual type fuels approach, or even exceed, the specific gravity of water, it is often difficult to remove the sodium and the water by centrifuging.

As mentioned, sulfur content of the fuel has long been considered detrimental toward cylinder and piston ring wear in a diesel engine. This has been explained as the reaction of the sulfur, upon combustion, becoming sulfur di-oxide or sulfur-tri-oxide. In the presence of water, they become sulfurous acid or sulfuric acid and causes corrosive wear. There is evidence that another reaction may also take place upon combustion between the salt, the water, and the sulfur oxides. Sodium sulfate and hydrochloric acid, (both corrosive) are formed.

Conditioning and Treatment

Recognizing that these compounds are present and that they may react among themselves upon combustion to cause wear, corrosion, and or slag deposits, what can be done to minimize these effects? Conditioning by filters, purifiers, clarifiers, and heaters, will remove most of the insoluble solids from the fuel, such as silicon, iron, and other metals which generally cause abrasive wear.

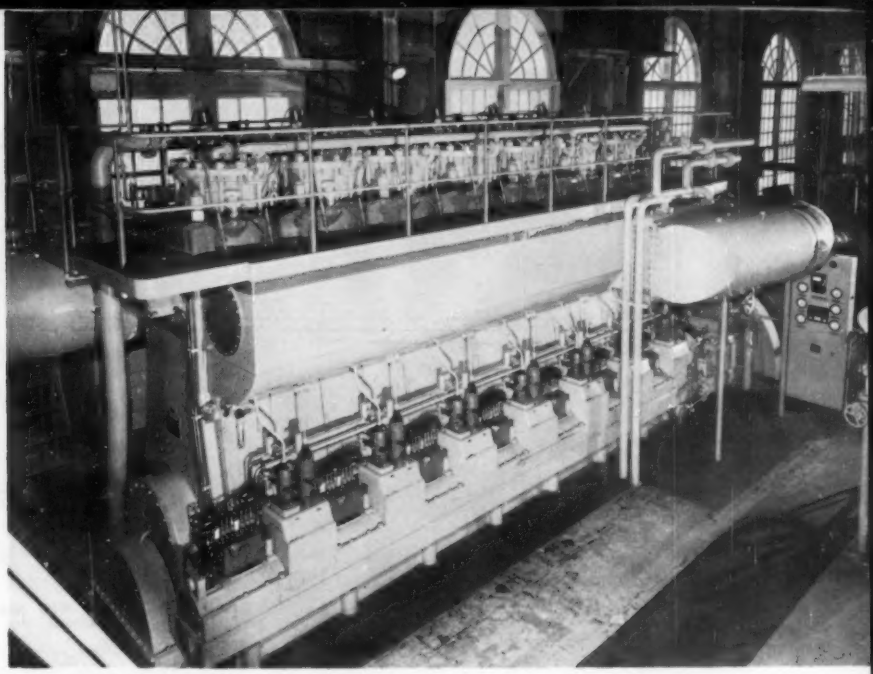
The optimum fuel temperature and throughput rate through the centrifuge should be established in order that as much as possible of the ash-forming material and salt water will be removed without adding to the burden of bowl cleaning and sludge removal. Even under ideal conditions, for each pound of sediment removed, an equal or greater amount of combustible material is also extracted.

Since it is not possible to remove the oil-soluble sulfur and vanadium nor all of the salt water and sodium compounds, the next best alternative is to render them harmless by means of a fuel additive. There is one additive, known as *Barsad*, which neutralizes the acidic by-products of combustion, the sulfurous and hydrochloric acids mentioned above. At the same time, tests have established the fact that this particular additive changes the nature of the vanadium oxides formed, in such a manner that they are non-corrosive.

This is accomplished by preventing the formation of the lower melting point vanadium pentoxide, the form of vanadium causing slag formation and corrosion. Other tests also show that *Barsad* will counteract the corrosive effects of the salt water remaining in the fuel. To accomplish these functions, this additive begins where the mechanical conditioning of the fuel leaves off—by introduction after centrifuging.

Summary

In conclusion, the savings to be effected by the use of low-cost residual fuels is considerable. If this saving is to be real, it is important that maintenance costs due to wear and corrosion should not increase to untenable levels, nor should other factors such as lubricating oil deterioration result from the use of sub-standard fuels. This can best be accomplished by means of an effective fuel additive.



Control side of latest Nordberg, a 7-cyl, 2-cycle dual-fuel unit which has seen 90% service in four calendar mo

Dual-Fuel Engines Power Cement Plant

Newest installation in the 8-engine, 14,750-hp San Antonio Portland Cement Company plant is a 3010-hp Nordberg.

A PAIR of dual-fuel engines are carrying the base load for the San Antonio Portland Cement Co., San Antonio, Texas. Utilizing inexpensive natural gas and small amounts of pilot oil, (an average of 6½ gph to each engine), their power generation is economical and has proven more reliable than purchased power for this large installation.

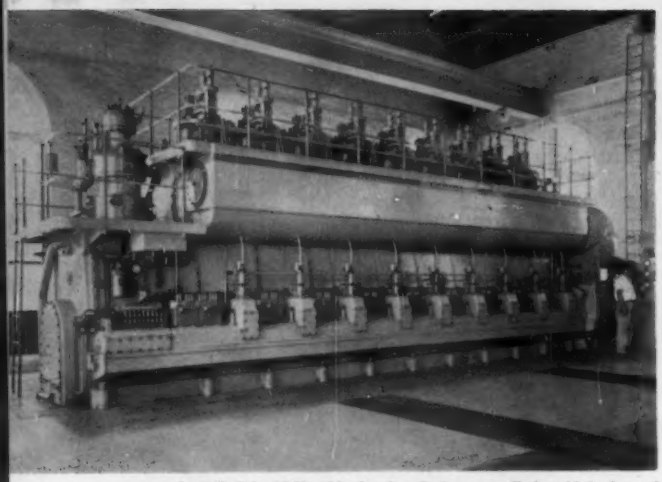
With a production capacity of 2,000,000 bbl of Portland Cement a year, the four kilns, two slurry thickeners, crusher and four finish cement mills demand a large amount of electric power. Of course, the electric load is a variable depending on mill operation, and the present load varies from 3000 to a peak of 6000 kw.

In 1948, a 3600-hp, 9 cyl, 21½ x 29-in, Nordberg, high pressure, *Duafuel* engine, rated 3600 bhp, was installed as the first step in a power plant modernization program. The second unit of the 2-engine, base load combination is a 7-cyl, 21½ x 31-in, 2-cycle, Nordberg, dual-fuel engine, rated 3010 bhp, which utilizes low pressure gas admission. Installation of the later engine was completed in June, 1953.

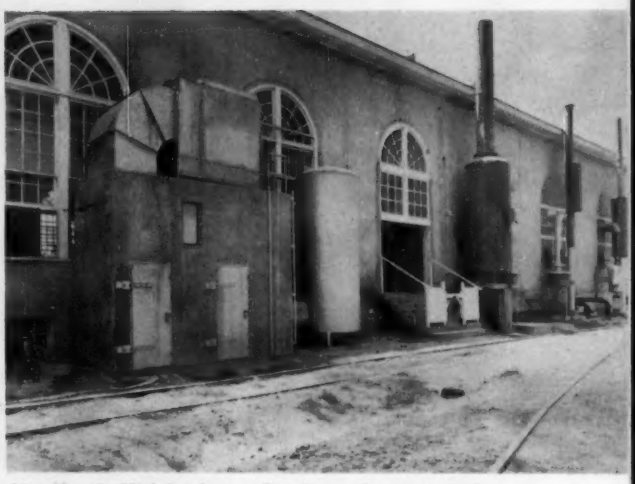
During the 12-month period ending in July, 1954, the two Nordberg engines compiled a good record for hours on the line. The 3600-hp unit delivered 13,330,000 kwh during 7909 hr of service, representing actual operation 90.2% of the time. For the same period, the smaller engine operated 6149 hr and produced 9,195,000 kwh. Prior to the installation of the second engine, the 9-cyl unit completed one 12-month period with the record of just 53 hr off the line, which means actual service 99.4% of the time. Although power plant operation does not usually demand full-time service for the new 7-cyl engine, it has been on the line over 90% of the time during four calendar months in the past year.

Mr. L. C. Mitchell, power plant superintendent, believes in operating his engines with a load of 2000 kw on the larger engine and 1650 kw on the smaller. When base-load requirements fall, resulting in a low, uneconomical load on the smaller engines, one of the older engines is substituted. This results in the lower use factor for the newer engine.

Although each engine is not equipped with separate gas meter, occasionally plant operation permits accurate gas flow determination to a single engine. These tests have shown fuel flow to be about 10.2 cu ft per kwh. For the 3010-hp engine, pilot oil flow averaged 6 gph. Using this figure for the 6,149 hr in the 12-month period previously discussed, when 9,195,000 kwh were generated, pilot oil consumption was 0.00402 gal per kwh for an entire year. Combined with the 10.2 cu ft per kwh gas consumption, this adds up to efficient and economical power production.



Installed in 1948, this 9-cyl unit has compiled a high dependability record. It was 99.4% on the line in one 12-mo period.



Atop the air filter housing, cooling tower also serves as incoming air washer. New engine snubber is right of open door.

Prior Installations

As the progressive San Antonio Portland Cement Co. has expanded to meet the increased demand for its product, the power plant has kept pace. In 1914, a 2-cyl oil engine filled the bill, while today 8 engines totaling 14,750-hp are required to supply the mill and the workers' village.

In 1926, the management began the installation of a series of engines starting with a 1000-hp, 8-cyl unit. Now there are five of these engines ranging in size from 1000 hp to 2000 hp, all of which were converted to dual-fuel in 1948. A 640-hp Busch-Sulzer engine, installed in 1938, is the only oil-burning engine still in service.

Mill expansion surpassed power plant capacity in 1948 and for three years it was necessary to purchase some power. Interruptions in this service, either with or without warning, while never severe, were five to six times more frequent than interruptions from the power plant.

Operation

Plant capacity is firm, but with 6,610-hp in two engines, these engines must be available a large part of the time. In fact, no engine in the plant is given extensive maintenance unless operation has indicated some need for overhaul. Cylinders are checked with an indicator at frequent intervals.

Natural gas, with a higher heating value (HHV) averaging 1000 Btu per cu ft, is supplied to the cement mill and power plant at 60 to 65 psig. Indicative of the mill's size is the fact that it is the largest single user of natural gas in San Antonio. A gas scrubber was installed for the first gas burning Nordberg, but experience proved that a scrubber was not needed. The gas main for the newer engine feeds directly to the engine through a regulator. Gas pressure at the engine header is 20 psig.

Fuel oil is purchased in the area and delivered to the underground storage tank by truck. Oil is pumped from the main tank to the individual day tank. A centrifugal separator is used to treat all of the fuel oil before it flows to the day tanks.

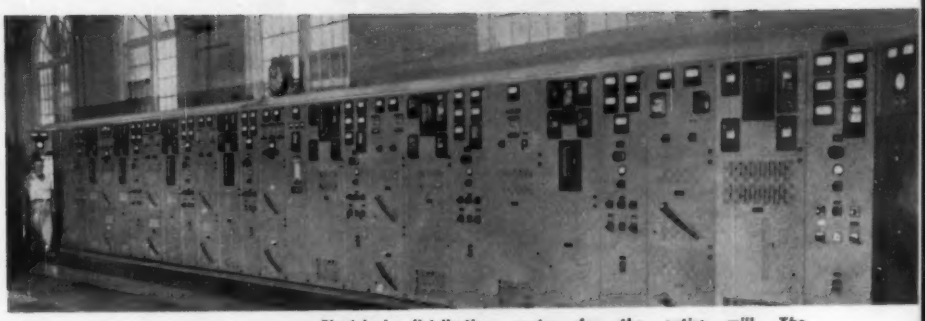
Fuel from the day tank for the new engine is pumped through the strainer where the pilot oil injectors and the gas valve actuators take suction. Pilot oil injection is independent of load, while the governor regulates the actuators to govern the engine. Should the flow of gas stop, the engine automatically switches to straight oil combustion.

With the high ambient temperatures that are so common to the southwest, the air induction system is carefully engineered. Outside air is precooled and washed by evaporative cooling on the suction side of the intake silencer and filter. A small, package-type cooling tower is used for the evaporative cooler. The low relative humidity, common in San Antonio, insures excellent cooling of the air. After passing through the filter, the air enters the engine-driven, lobe-type, scavenging blower. A cooler after the blower reduces the temperature again so it enters the manifold to the cylinders at less than 100°F.

Air flow is automatically varied for engine load with a controller actuated by exhaust temperature. Compressed air operates a butterfly valve in the by-pass line which connects the discharge and suction side of the blower.

In this manner, air is recirculated through the blower at low loads to maintain a high exhaust temperature with the attendant economical operation.

Mineral oil is used in the lubricating system. Filtration is provided by a by-pass type purifier using a fullers earth cartridge. Cartridges are changed when the condition of the oil, observed through a sight glass, indicates the need. Filter life is about six months.



Electrical distribution center for the entire mill. The modern board is equipped with a synchroscope at either end.

Auxiliary Equipment

An induced-draft cooling tower cools the water which is circulated through the oil cooler, then through the heat exchanger on the closed jacket water system, and returned to the tower. A separate line supplies cool water to the air cooler on the discharge of the scavenging blower.

A well instrumented alarm and gauge panel is located near the generator end of the engine. Alarms are installed for water and lube oil pressure and temperature, and for high or low level in the fuel tank. Gauges indicate various oil and water pressures including the pressure of starting air which is drawn from a plant-wide system.

Electrical generation and distribution is at 480-v. Since the power plant is located near the load center, low voltage distribution is permitted. A modern electrical panel extending along one wall of the building is the distribution center to the principal mill sections.

All engines are arranged in the single story, high-roofed, brick building. A basement contains many of the auxiliaries such as fuel tanks, lube oil tanks, heat exchangers, oil purifiers, pumps for water and oil, etc. With so many different pipes in the basement area, a color code system permits rapid identification. Red indicates a fire zone; blue is soft water; green for raw water; yellow, lube oil; brown, fuel oil; white, compressed air; and orange is for gas. The lines are identified by painting valve handwheels the correct color; however, gas lines are fully painted.

Summary

Indications of the efficient operation are apparent throughout the plant. The floor is neatly painted and rubber mats protect the most used parts, while many guard rails are brass polished to a high luster.

The San Antonio Portland Cement Co. power house is a graphic illustration that good equipment, adequately maintained, and operated with skill in an orderly plant, can produce dependable, low cost power.

MONTH	Kwh Generated 3,010-hp	3,600-hp	Engine Hours 3,010-hp	3,600-hp	% Time on Line 3,010-hp	3,600-hp
AUG. '53	266,000	1,300,000	173	743	23.2	100.0
SEPT.	746,000	990,000	490	625	68.2	86.8
OCT.	1,117,000	1,287,000	708	742	95.4	99.8
NOV.	865,000	1,206,000	569	719	79.0	99.8
DEC.	431,000	1,188,000	287	724	38.4	97.5
JAN. '54	796,000	528,000	515	322	69.3	43.3
FEB.	598,000	1,145,000	400	672	59.6	100.0
MAR.	328,000	1,263,000	236	742	31.7	99.8
APR.	1,004,000	1,237,000	677	718	94.0	99.8
MAY	1,084,000	766,000	741	450	99.7	60.5
JUNE	910,000	1,154,000	628	711	87.4	98.8
JULY	1,050,000	1,266,000	725	741	97.5	99.7
TOTAL	9,195,000	13,330,000	6,149	7,909	70.2 Av.	90.4 Av.

Principal Equipment—New Engine

Engine	Nordberg Manufacturing Company
Alternator	Westinghouse Electric & Mfg. Corp.
Gas	San Antonio Public Service Board
Actuator valves	American Bosch Corporation
Gas regulator	Fisher Governor Company
Centrifugal separator	DeLaval Steam Turbine Company
Fuel filter	Wm. W. Nugent & Company, Inc.
Governor	Woodward Governor Company
Cylinder lubricators	Manzel, Inc.
Lube oil strainer	Nordberg Manufacturing Company
Lube oil purifier	Houdaille-Hershey, Inc.
Auxiliary lube pump	Blackmer Pump Company, Inc.
Lube oil cooler	Graham Manufacturing Company
Jacket water pump	Ingersoll-Rand Company
Jacket water cooler	Graham Manufacturing Company
Cooling tower	J. F. Pritchard & Company
Evaporative air cooler	The Marley Company
Air filter	American Air Filter Company, Inc.
Scavenging blower	Roots-Connersville Blower Corp.
Air control	Bristol Company
Air cooler	Young Radiator Company
Snubber	Burgess-Manning Company
Gauge panel	Nordberg Manufacturing Company
Alarms	Viking Instruments, Inc.
Gauges	J. E. Lonergan Company
Pyrometer	Alnor, Illinois Testing Labs., Inc.
Switchboard	Westinghouse
Air compressor	Ingersoll-Rand Company

Size of the Sno-Freighter is shown comparatively by the men standing beside the power control car. The transporter is being loaded with pipe for a test run at the manufacturer's proving ground.

LeTourneau's "Sno-Freighter"

Powered by two diesel generating sets, the "Sno-Freighter" will serve as an overland freight link between the areas that were normally isolated by arctic winter cold and snow.

HIGH flotation when carrying heavy loads and ability to operate in sub-zero arctic winters were prime requisites for the "Sno-Freighter". A need stimulated development of this huge vehicle while earlier and somewhat similar vehicles provided a basis for design.

Alaska Freight Lines needed such a vehicle to serve communities normally isolated by winter cold and snow. R. G. LeTourneau, Inc. was a logical choice for the builder because of its experience in developing and producing large, special purpose, rubber-tired vehicles such as the "Rubber-Tired Freight Train" for desert operation, the "Sno-Buggy", and others. Both firms went into a huddle and came up with the Sno-Freighter.

Just six short weeks elapsed from the drawing board to delivery. This tight schedule was necessary if operational tests were to be made over actual freight routes before the frozen Alaska rivers began to thaw. Fabrication of the principal structures by welding helped to meet this production schedule as did repetitive design of the five cargo-carrying units. Repetitive design also simplified parts cutting and fabrication.

In General. . . .

the Sno-Freighter is a 274-ft transporter coupled together in six sections, a power-control car, and five cargo-carrying units. The power-control car is divided into four compartments including control cab, crew's quarters, power, and fuel. This is the order from front to back. The body of the control car is of welded aluminum construction and insulated against the sub-zero tempertures. All windows are tinted green to cut down glare.

Other special features necessary for arctic operation include thermostatic control of ventilation to the engine, custom preparation of lubricants to avoid congealing in extreme cold, natural rubber for electrical cable insulation and oil seals to maintain pliability in arctic temperatures, and lever-operated disconnects on electric jumpers for uncoupling cars without exposing hands to the weather.

Actual dimensions of the freighter are: length 274 ft; width 16 ft. 4 in; height 17 ft, 6 in. The highest point is the operator's cab, while the decks are 8½ ft off the ground. The latter provides protection for the cargo.

Operation. . . .

is similar to that of a diesel-electric locomotive in that diesel-electric generating sets supply power to electric motors in the wheel assemblies. Each car is mounted on four electric wheels for a total of 24 drivers. Power is supplied by a pair of 400-hp Cummins NHVGI-1200 diesels, direct-connected to an AC and a DC generator. Generators are coupled to the engine flywheel and mounted inline on the frame with each engine.

DC generators power the electric wheel motors which are mounted inside the tubular steel axles. The wheel motors pinion gear drives a gear train built into the hub. Hubs mount flush with the end of each axle and rims with the tires already mounted are bolted to them, completing the electric wheel. Ventilation for the wheel motors is provided by a double-ended, motor-driven fan mounted at the center of the axle.

Three motor-generator sets provide power for excitation of the main generators, excitation of the DC-drive motor fields, and for holding wheel motor brakes in the disengaged position.

Direction, speed, and/or power is controlled by the polarity and magnitude of the DC generator's output. This is controlled manually with a potentiometer in their field circuits. The potentiometer is the operator's principal control.

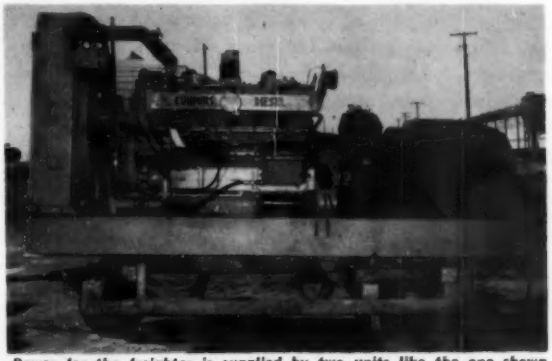
AC power is used for control circuits, motor-generator sets, steering, and winch motors. The AC system is designed for 300-v, 120-cycle, 3-phase current. AC motors of the squirrel cage, induction-type are used for localized power applications, with motor pinions direct-driving gear-reduction units.

The steering motor gear box has a large output pinion which works against a gear segment to steer the power-control car's front axle. The cargo cars are mechanically steered by simple coupling devices which cause them to track the car immediately ahead. As on all LeTourneau electrically powered and controlled equipment, limit switches are used to interrupt power to the control motor and set the brake whenever a driven component reaches the desired limitation of its travel. AC motors have conical-shaped, bi-metallic friction brakes. When power is applied to the motor, 3-phase coils disengage the brake. Coils springs set the brake when power is interrupted for any reason.

The system of electric drive and control employed by LeTourneau makes use of one phase of its AC power as a control voltage. This single-phase power operates heavy-duty relays whenever heavy currents must be interrupted. Series field current direction is altered automatically at each wheel-drive motor when the polarity of applied voltage is reversed. Heavy-duty contactors are required to start, stop, and reverse the AC control motors.

Brakes for the electric wheels consist of stationary steel plates and rotating plates with sintered metal surfaces splined directly to the motor armature hub. The friction plates are engaged by spring action or held open magnetically by an electro-magnetic coil built into the motor endbell. Brake coils are DC-powered from one of the motor-generator sets.

Components of the "electric wheel" are shown above and below. The large 88-in wheels provide high floatation. Wheel motors are mounted inside the tubular axles and drive through gear reduction which is an integral part of the wheel.



Power for the freighter is supplied by two units like the one shown. Each engine drives directly, an AC and DC generator, mounted in-line.

Electric wheel brakes are used principally for emergency stopping and parking. Normally, braking is taken care of by regeneration in the DC drive system similar to a dynamic brake on a diesel-electric locomotive. A special circuit helps slow the machine when wheel motors are overdriven by taking the energy imparted to the system and dissipating it as heat in resistance grids.

At least eight inspections are given the typical worn cylinder liner from the moment it enters the reconditioning plant until it is ready to set forth on its homeward journey.

Reconditioning Diesel Locomotive Parts

Reclamation practices must stand two tests—economy and acceptable service life. Experience points to certain procedures as the most practical.

AS the railroads' diesel fleets become older, there is more and more need to standardize repair and reconditioning procedures. Some authorities feel the approach to reclamation problems is from too many directions. Actual service-tests of repaired parts is the most certain and acceptable approach, but this takes too long—months, possibly years. Meanwhile needs accumulate for acceptable practices. Metallurgical knowledge from years of study and research can provide a fairly sure and much quicker basis for solutions.

Equipment manufactured by each locomotive builder is much the same, regardless of the railroad on which it operates. Allowing for differences in age, local operating conditions, particularly terrain, climate, and prevailing weather, reclamation problems are much the same.

Worn parts must be reconditioned, or scrapped and replaced with new, more costly pieces. Precision machine work to a standard undersize can often make a worn part serviceable again. Application of metal to worn working surfaces, restoring to the original size is a common practice generally, with some exceptions.

In general, there are three means of adding metal to worn parts. These are plating, metal spraying and welding. Each method has its place in reclamation, and sometimes one may serve equally as well as another. The final selection depends on which is most economical, considering the service obtained from the reclaimed part.

Advantages recommending the selection of electroplating for reconditioning are as follows:

1. A minimum of surface machining preparation is required, and this means less structural weakening of the part to be reclaimed.

2. No deformation of base metal results, and heat treat qualities are not impaired. This is due to the relatively low temperatures, averaging about 150°F, at which electroplating processes on chromium, nickel and iron (the three most important) are accomplished.

3. When the process is done properly a perfect bond results between base and plated metal. Tests show that the base metal will rupture before the plated metal will separate from it, insuring a resistance to shear superior to mechanical types of bonding.

4. On low-tolerance parts electroplating permits close control of metal applied, within a few ten-thousands of an inch if desired, minimizing after-plating machining.

Cylinder liners have been a major application of plating, both as to number of units reclaimed and total money saved. More liners have been salvaged than any other item. This specialized work is done in plants of outside concerns which have the necessary equipment, and the "know-how" based on research and long experience.

Railroads are expected to clean thoroughly and examine all liners for cracks, excessive corrosion, and other defects making them unfit for service before sending them out for plating. Upon receipt, the plating concern recleans and inspects the liners so that no costly work will be wasted on defective units.

Generally two methods are used, depending on the de-

gree of wear. For liners worn not in excess of 0.030-in oversize, one of the specialized types of chrome plating is used to restore liners to standard diameter. For liners worn in excess of 0.030-in in diameter, a combination of iron plating and chrome plating is used.

Why Chromium?

Chromium properties can best give the answer. As plated, they are as follows:

1. It is harder than any other metal in general use for engine cylinders, and this hardness is maintained throughout the thickness of the case.

2. Chromium, unlike many metals, maintains its hardness very well within the range of cylinder wall operating temperatures. It has a melting point of approximately 800°F higher than cast iron and higher than steel.

3. Chromium's thermal conductivity is 40% higher than that of cast iron or steel. This property allows heat to get away faster through the chromium, permitting lower cylinder-wall temperatures.

4. It has the lowest coefficient of friction of any of the generally used structural metals. Add to this the fact that in porous chromium the area of contact surface is reduced approximately 30%, and you can very well see that the friction factor is reduced even further. As a result piston rings actually wear less. Therefore considerable additional life can be expected.

5. Chromium's resistance to corrosion is an important contributor to its low wear rate. It is only slightly attacked by sulfuric acid, and not attacked by nitric acid.

Chrome's resistance to atmospheric corrosion is well known. Chrome-plated cylinders may be stored indefinitely, with little or no protection to the chrome surface.

Chrome Plating

One method of chrome plating is Van der Horst's patented "Porus-Krome" process. In brief, it works as follows. After the cleaning and inspection step, bores are trued by honing. Further surface preparation consists of electroetching the bore. Plating is next.

Chrome is electrolytically deposited on the bore directly from a bath of chromium oxide, water, and a slight amount of sulfuric acid. By close control of anode shape and location, bath strengths and temperatures, and electrical control, the desired chromium thickness is deposited.

This process leaves a nodular surface which exhibits a fine network of checks. These checks are due to tensile stresses beyond the ultimate strength of chromium and leaves the plate with the appearance of dried mud. This surface does not yet have oil-retention ability.

By reversing the electrolytic process an etching action takes place. Depth and extent of the etch is carefully controlled because it is these recesses that, following final honing to size, will serve as the minute oil reservoirs for retention of the lube oil necessary for cylinder lubrication. The final honing process must be carefully done by an experienced operator. Considerable "know-how", is necessary to arrive at the correct size while remaining within the limits of acceptable porosity.

Prior to the application of chromium, the cylinder bore must be honed to a micro-finish. This insures only one plane of surface geometry, absolutely necessary for proper ring seating.

Acceptable porosity limits are 20% minimum and 50% maximum. Percentages represent relieved area as compared to total surface area. Every liner at final inspection is checked with the borescope at 50X magnification to insure these limits.

Results With Chromium

Results with chromium-plated liners, from a general consensus, indicate that they outlast unprocessed cast iron liners at least three to one. Occasional reports are received that chromium has peeled from liners. Investigation of these cases usually has indicated this was caused either by improper preparation for plating or wrong procedure in finishing chromium surface after plating. Currently, three leading diesel locomotive builders use chromium-plated liners in new engines.

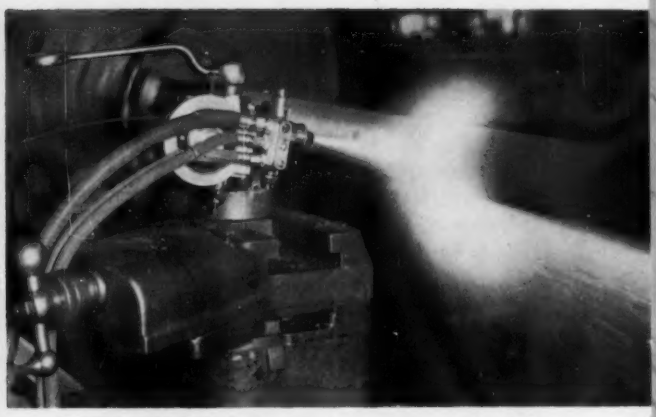
Several railroads report using chromium-plated surfaces on air compressor cylinder bores with success. This practice is 2 or 3 years old.

Dense chrome plating is suitable for reclamation of a number of diesel locomotive parts, including EMD parts as follows: rocker arm shafts; piston pins; blower drive gear; blower drive stub shaft; idler stub shaft; idler gear No. 2; camshaft stub shaft; Alco and Baldwin wrist pins; and crankshafts of all makes.

Iron Plating

This is one of the most recently developed types. Physical properties of this purest form of iron possible are: a tensile strength of 75,000 psi; a Brinell of 200-250; and a yield point of 60,000 psi.

After preparatory surface operations, the actual chromium deposition process requires careful treatment. Close control must be given to anode shape and location, bath strengths and correct temperatures, to achieve the exact layer of thickness.



Metal spraying is a "cold process". The spray gun combines a gas head for melting coiled wire fed to it, and a compressed air nozzle which atomizes the liquified metal for high velocity spraying. The air blast keep the sprayed surface "cool."

Cylinder liner iron plating was developed after it was found that a considerable number of liners removed from service, were worn over the 0.030-in limit, and had to be scrapped. Attempts to restore them to original size or within the 0.030-in limit, by chrome plating only, was found too costly and impractical. Iron plating is a build-up to standard size as an underlay for Porus-Krome plating on liners worn in excess of 0.030-in oversize.

This work is done by another Van der Horst patented process known as "Vanderloy". The procedure consists of electroetching of the trued liner bore, as described for chrome plating, and plating iron from a soluble anode enclosed in a synthetic bag. The deposit is nearly 100% pure iron, as the impurities are collected in the synthetic bag. The surface of the Vanderloy is then etched, and chromium applied to the iron plating.

Cylinder heads (EMD) have been successfully repaired by application of iron plating to worn valve seats. Preparation consists of grinding seats true. After the plating deposit of metal, seats are machined—first by reaming then by rough grinding to standard dimensions. Lapping is done in the usual way.

One distinct advantage of this method of valve seat restoration is the lack of any head deformation. This is due to the low temperatures at which the plating metal is deposited. This is important in keeping head reclamation costs to a minimum. In similar repairs by welding, a major part of the expense is in truing all fit surfaces of the head, which warps in the welding process.

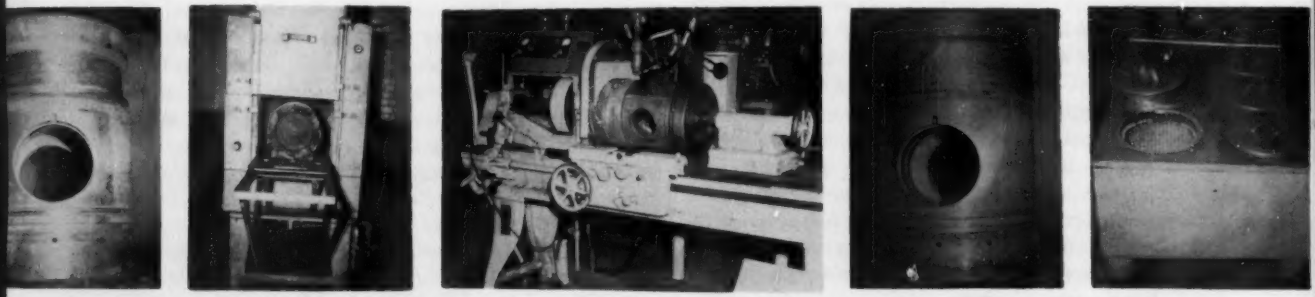
Metal Spraying

In the metallizing process, wire of any common metal is automatically drawn through a special tool (or gun) to an oxygen-gas flame, where it is melted and then atomized by a compressed air blast which carries the metal particles to a previously prepared surface. The particles "mesh" on the surface of the part being sprayed for a metal coating of almost any desired chemistry.

This is known as a "cold" process, since the air blast keeps the sprayed surface cool. Thus there is freedom from warping, distortion, or thermal stress.

Surface preparation may be electrical fuse-bonding, or mechanical means, such as threading, grooving, knurling, or sand or grit blasting. In some instances only a thorough cleaning is necessary.

Metal spraying equipment is made up of a drive unit, a spray gun, and auxiliary apparatus. The drive unit consists of a controlled speed motor (air or electric), plus a set of wire drive rolls which pull the wire from the coil on a set of semi-automatic reels and straighteners. These rolls feed the wire at a uniform speed, under control of operator, to the gas head.



Both preheating and slow cooling are necessary in piston reclamation by welding. First step is to machine out the ring grooves. Piston is then placed in a 250°F-300°F furnace and sent on to the shielded-arc welding lathe for weld buildup. The welded piston next enters an insulated bin for slow cooling and is now ready for the remachining of its ring grooves.

The spray gun consists of a combined gas head and a compressed air nozzle, which serves to melt the wire, and atomize the molten metal, spraying it at a high velocity to the surface to be coated. Most guns are similar.

Auxiliary apparatus consists principally of means to maintain the air blast dry and clean, regulators for gas and oxygen, and flow meters for proper flame balance.

Parts reconditioned by metallizing generally consist of traction motor armature shafts and main generators on which compression fits are restored; outer race fits in motor and generator housings; bearing seats on various shafts; and other worn surfaces.

For most compression fits, cleaning or slightly undercutting the surface is the only preparation necessary. A molybdenum alloy wire generally is used as the filler material. It provides a good undercoat where a composite coating is desired on the finished product.

High molybdenum alloy wire is said to be satisfactory for spraying on smooth, clean surfaces of steel, monel metal, nickel alloys, cast iron, magnesium and most aluminum alloys. It is said to provide a fair bond to lead, tin, zinc, and galvanized iron. It does not bond well to copper, brass, bronze, or chrome plate.

The nature of the bond thus produced approximately equals the strength of most sprayed metals, in a direction perpendicular to the coating. Appearance of the deposit is similar to sprayed steel, but of finer texture.

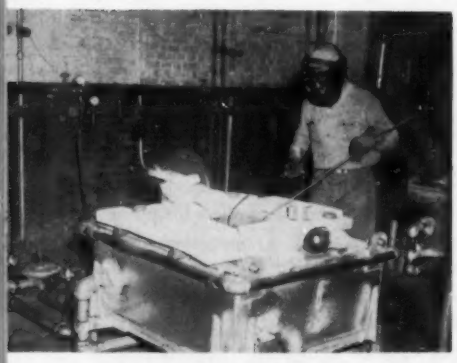
Limitations in the use of high molybdenum alloy exist, as in other methods of bonding. A thorough understanding of these restrictions is absolutely essential to avoid trouble. This knowledge includes such characteristics as: the tendency of all sprayed metals to contract or shrink, varies with different metals; total tensile stress in coating increases with its thickness; no shear stress develops at the bond on a cylindrical piece where coating is continuous, but on a non-continuous surface such as on a shaft with a keyway or on one side of a flat block, the shear stress on the bond may be extremely high; and this wire may not give a satisfactory surface preparation for the application of hard surfacing alloys, because of the higher temperatures required to fuse them.

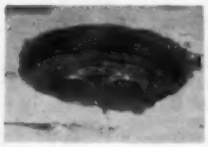
Welding

Repairing worn parts by welding has been practiced on railroads for many years. On modern motive power, some welding procedures followed are merely developments of long-standing methods, such as welding cast steel truck frames and other similar parts. Procedures followed in welding cracks in diesel crankcases, which are of built-up welded construction, are developments to suit the need. However, welding aluminum pistons and cast iron cylinder heads is accomplished by relatively new procedures.

Aluminum piston reclamation is now a standard operation on many roads. Both the oil cooled and solid type pistons can be successfully reclaimed at a fraction of the cost of new parts. Either of two inert gas welding methods, tungsten arc or metal arc, commonly referred to as "Tig" and "Mig" respectively, may be used. Preheating and slow cooling are required in all instances.

Procedure for reclaiming aluminum pistons removed from service because of worn ring grooves in ring carrier bands (where new bands are not applied), is approximately as shown in accompanying photos.





Welding of valve seats is done through openings in the heating furnace. Opening in the asbestos-lined lid of furnace is shown. Carbon plugs have been inserted in the valve holes.

Piston tops are being welded by means of a rotating rig, also used for welding top of ring carriers when new ones are applied. At right, repairs are made to cracks in crown of piston.

Methods for reclaiming solid aluminum pistons are about the same, except for operations having to do with the separate ring carrier band.

Cylinder head reclamation by welding is a rather general practice. Handling hydrostatically defective heads which seem to be suitable for reclamation, consists of heating them in a furnace to 1000°F. for 3 to 4 hr, and then testing for leaks. This procedure should show up any internal cracks or defects, making it possible to determine whether there are any defects which can not be repaired by welding. Furnace size depends on the volume of work.

After testing, those heads found suitable for welding are machined on a drill press. Three valve seats are merely cleaned up with a pilot fly cutter, while the other seat opposite the air inlet (where most of cracks in head are found) is cut 7/16-in deep with a 3/8-in radius round nose tool. The head is then ready for the welding furnace.

(Continued on page 69)

How Tight?

You can lick a lot of hidden troubles by proper torquing.

Recommendations for Caterpillar engines are given.

HOW tight? Finger tight and hand tight are two degrees of tightness. There is little question about these terms. They are readily understood and mean about the same thing to all mechanics. But, is there such a thing as "wrench" tight? What could that mean? It could mean almost any heavy pull on most any length wrench.

That is not a very definite statement of tightness to say the least. In terms of wrench handles and human strength "tight" means different things to different people. "Correct" tightness will vary from day to day for the same person. "Tight" means different things to bolts too. The difference is in their size, thread type and the material used.

To tighten a bolt, stud, or capscrew, it must be turned down until it begins to stretch. Any degree of bolt stretching will have required some torque, no matter how slight. Tightness may be described as "finger tight" (air cleaner wingnuts), "seated" (fittings), "snugged" (drain plugs), "tight" (manifold studs) and "so many lb-ft tight" (cylinder head studs). The first four are less definite tightness descriptions and are used because it is not practical or economical to torque all bolts to close tolerances.

Conversely, "so many lb-ft torque" is used because it is practical and necessary to tighten certain items correctly. For example, hydraulic pumps have small internal clearances and, while it is desirable to have the parts of these units assembled tightly, too much tightening will cause distortion, reducing internal clearance. Main and connecting rod bearings are round only when correct torque is applied to the cap nuts. Improper tightening will result in an out-of-round condition. Excessive cylinder head stud nut tightening will result in distortion which can cause leakage, warping or even cracking.

Specific values are stated where the amount of tightness is critical, since it is important to obtain the correct clearance or the right gasket crush and yet not tighten excessively. The torque wrench was developed to accurately measure the amount of applied torque and consistently obtain critical values. Proper use of this tool calls for bringing torque up in increments so that you always have a steady pull. Jerking the wrench will result in higher torques than indicated.

Reliable operation of your equipment depends largely on correct adjustments and a torque wrench which is accurate and if properly used will give the best and most consistent results.

TORQUE VALUES FOR NUTS, BOLTS, AND CAPSCREWS ON CATERPILLAR-BUILT EQUIPMENT*

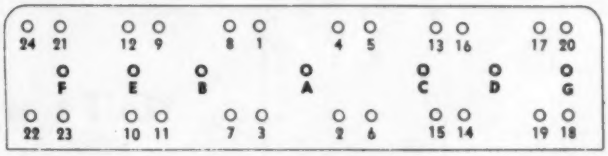
NOMINAL THREAD Diameter	TORQUE (lb. ft.) Min.	Max.	TORQUE (lb. in.) Min.	Max.
1/4"	6	10	72	120
5/16"	13	17	156	204
3/8"	24	30	288	360
7/16"	39	47	468	564
1/2"	60	70	720	840
9/16"	86	104	1032	1248
5/8"	118	142	1416	1704
3/4"	210	250	2520	3000
7/8"	335	405	4020	4860
1"	500	600	6000	7200

These torque values are applicable only to Caterpillar bolts, nuts, and capscrews.

TORQUE VALUES FOR MAIN BEARINGS AND CONNECTING ROD BEARINGS

ENGINE SIZE	MAIN BEARINGS		CONNECTING ROD BEARINGS	
	lb. ft.	lb. in.	lb. ft.	lb. in.
4 Cyl. 3¾" Bore	96	1150	58	700
4 Cyl. 4" Bore	96	1150	58	700
4 Cyl. 4¼" Bore	121	1450	58	700
4 Cyl. 4½" Bore	121	1450	58	700
6 Cyl. 4¼" Bore	121	1450	58	700
6 Cyl. 4½" Bore	121	1450	58	700
6 Cyl. 5⅛" Bore–7F8164 Cap	120	1440	121	1450
6 Cyl. 5⅛" Bore–4H1728 Cap	167	2000	121	1450
4 Cyl. 5¾" Bore–⅝" Nuts	58	700	125	1500
⅞" Nuts	375	4500		
6 Cyl. 5¾" Bore–⅝" Nuts	58	700	125	1500
⅞" Nuts	375	4500		
8 Cyl. 5¾" Bore (D17000)	442	5300	125	1500
8-12 Cyl. V-type	442	5300	150	1800

It is permissible to exceed the values shown for connecting rod and main bearing nuts by the amount necessary to turn the nut to the next slot for alignement with the cotter pin hole.

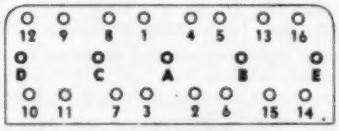


4½" BORE, 6 CYLINDER
DW10, D6 TRACTORS, No. 12 MOTOR GRADER, D318 ENGINE

Step A — Tighten in alphabetical sequence to 42 lb. ft. torque (500 lb. in.)
Step B — Tighten in numerical sequence to 90 lb. ft. torque (1080 lb. in.)
Step C — Tighten in numerical sequence to 130 lb. ft. torque (1560 lb. in.)
Step D — Tighten in alphabetical sequence to 58 lb. ft. torque (700 lb. in.)

Expected tightness after run-in to be 110 lb. ft. (1320 lb. in.) torque on numbered studs and 46 lb. ft. (550 lb. in.) torque on lettered studs.

Precombustion chambers to be tightened to 200 lb. ft. (2400 lb. in.) torque.

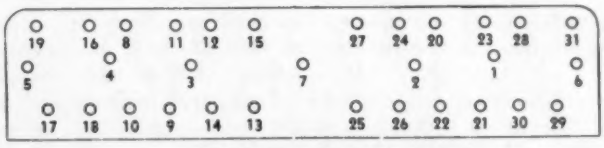


4" BORE, 4 CYLINDER
D2 TRACTOR, No. 212 MOTOR GRADER, D311 ENGINE

Step A — Tighten in alphabetical sequence to 45 lb. ft. torque (540 lb. in.)
Step B — Tighten in numerical sequence to 70 lb. ft. torque (840 lb. in.)
Step C — Tighten in numerical sequence to 95 lb. ft. torque (1140 lb. in.)
Step D — Tighten in alphabetical sequence to 60 lb. ft. torque (720 lb. in.)

Expected tightness after run-in to be 90 lb. ft. (1080 lb. in.) torque on numbered studs and 55 lb. ft. (660 lb. in.) torque on lettered studs.

Precombustion chambers to be tightened to 150 lb. ft. (1800 lb. in.) torque.

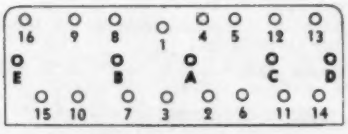


4¼" BORE, 6 CYLINDER
DW10, D6 TRACTORS, No. 12 MOTOR GRADER, D4600 ENGINE

Step A — Tighten in numerical sequence to 90 lb. ft. torque (1080 lb. in.)
Step B — Tighten in numerical sequence to 130 lb. ft. torque (1560 lb. in.)

Expected tightness after run-in to be 110 lb. ft. (1320 lb. in.) torque.

Precombustion chambers to be tightened to 150 lb. ft. (1800 lb. in.) torque

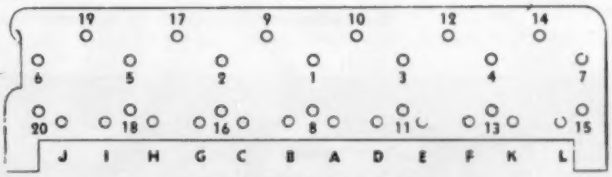


4½" BORE, 4 CYLINDER
D4 TRACTOR, No. 112 MOTOR GRADER, D315 ENGINE

Step A — Tighten in alphabetical sequence to 42 lb. ft. torque (500 lb. in.)
Step B — Tighten in numerical sequence to 90 lb. ft. torque (1080 lb. in.)
Step C — Tighten in numerical sequence to 130 lb. ft. torque (1560 lb. in.)
Step D — Tighten in alphabetical sequence to 58 lb. ft. torque (700 lb. in.)

Expected tightness after run-in to be 110 lb. ft. (1320 lb. in.) torque on numbered studs and 46 lb. ft. (550 lb. in.) torque on lettered studs.

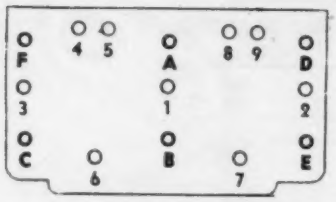
Precombustion chambers to be tightened to 200 lb. ft. (2400 lb. in.) torque.



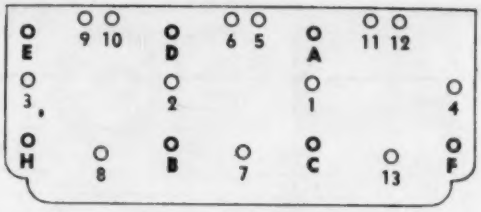
5⅛" BORE, 6 CYLINDER
DW15, DW20, DW21 TRACTORS, D326, D337 ENGINES

Step A — Tighten nuts in numerical sequence to 122 lb. ft. (1464 lb. in.) torque.
Step B — Tighten nuts in alphabetical sequence to 63 lb. ft. (755 lb. in.) torque
Step C — Tighten nuts in numerical sequence to 200 lb. ft. (2400 lb. in.) torque.
Step D — Tighten nuts in alphabetical sequence to 100 lb. ft. (1200 lb. in.) torque.

Precombustion chambers to be tightened to 300 lb. ft. (3600 lb. in.) torque.



5¼" BORE, 4 CYLINDER
D7 TRACTOR, D8800 ENGINE

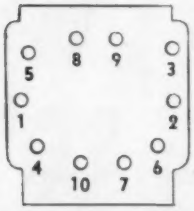


5¼" BORE, 6 CYLINDER
D8 TRACTOR, D13000 ENGINE

Step A — Tighten in numerical sequence to 60 lb. ft. torque (720 lb. in.)
Step B — Tighten in alphabetical sequence to 150 lb. ft. torque (1800 lb. in.)
Step C — Tighten in alphabetical sequence to 200 lb. ft. torque (2400 lb. in.)
Step D — Tighten in numerical sequence to 90 lb. ft. torque (1080 lb. in.)

Expected tightness after run-in to be 167 lb. ft. (2000 lb. in.) torque on lettered studs and 58 lb. ft. (700 lb. in.) on numbered studs.

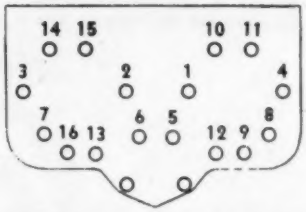
Precombustion chambers to be tightened to 223 lb. ft. (2675 lb. in.) torque.



5¼" BORE, 8 CYLINDER
D17000 ENGINE

Step A — Tighten in numerical sequence to 63 lb. ft. torque (750 lb. in.)
Step B — Tighten in numerical sequence to 100 lb. ft. torque (1200 lb. in.)

Expected tightness after run-in to be 71 lb. ft. (850 lb. in.) torque.

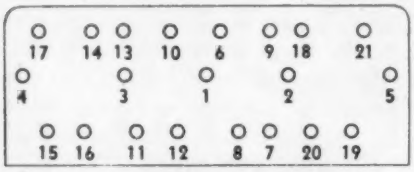


5¼" BORE, 12 or 8 CYLINDER
D397, D386, D375, D364 ENGINES

Step A — Tighten nuts in numerical sequence to 125 lb. ft. torque (1500 lb. in.)
Step B — Tighten in numerical sequence to 200 lb. ft. torque (2400 lb. in.)

Expected tightness after run-in to be 175 lb. ft. (2100 lb. in.) torque.

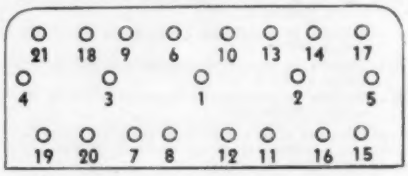
Precombustion chambers to be tightened to 223 lb. ft. (2675 lb. in.) torque.



3¾" BORE, 4 CYLINDER
D2 TRACTOR, No. 212 MOTOR GRADER, D3400 ENGINE

Step A — Tighten in numerical sequence to 60 lb. ft. torque (720 lb. in.)
Step B — Tighten in numerical sequence to 80 lb. ft. torque (960 lb. in.)

Expected tightness after run-in to be 58 lb. ft. (700 lb. in.) torque.

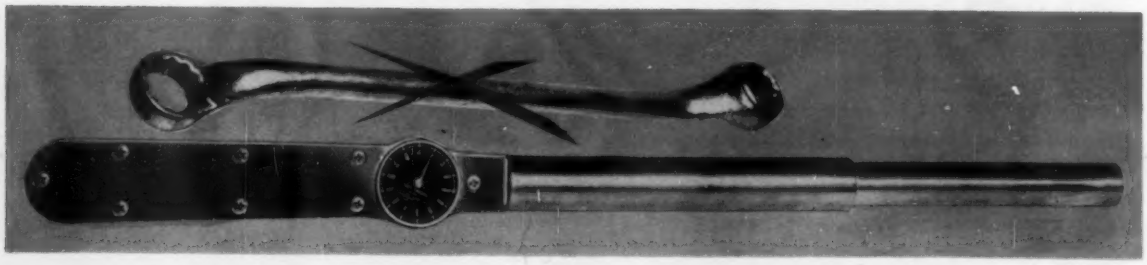


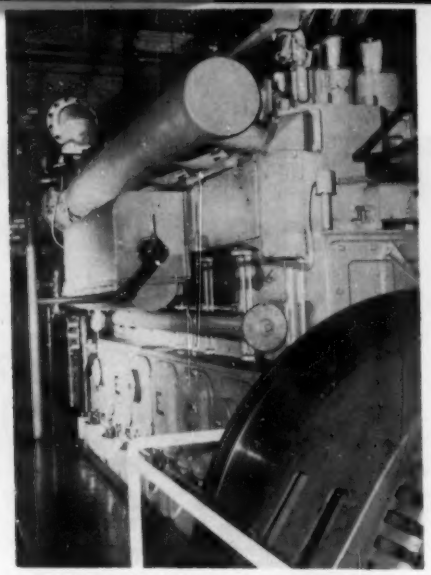
4¼" BORE, 4 CYLINDER
D4 TRACTOR, No. 112 MOTOR GRADER, D4400 ENGINE

Step A — Tighten in numerical sequence to 90 lb. ft. torque (1080 lb. in.)
Step B — Tighten in numerical sequence to 130 lb. ft. torque (1560 lb. in.)

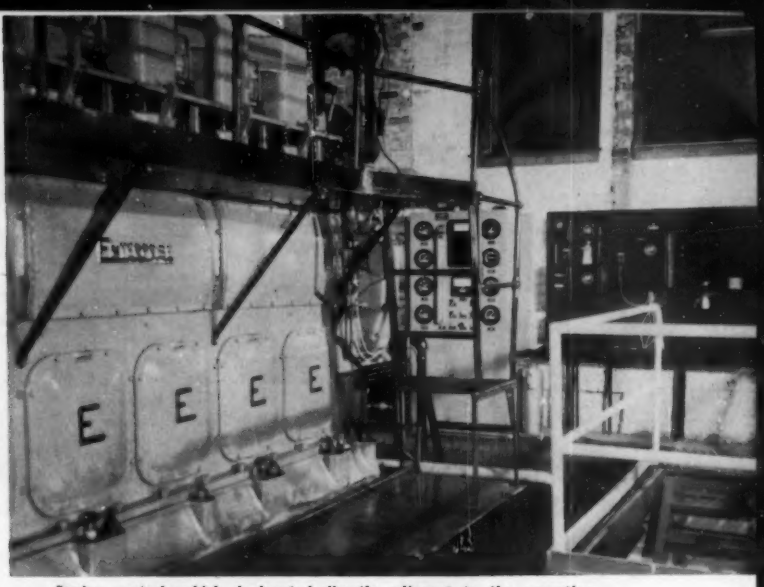
Expected tightness after run-in to be 110 lb. ft. (1320 lb. in.) torque.

Precombustion chambers to be tightened to 150 lb ft. (1800 lb. in) torque.





Manifold side of the new Enterprise engine showing intake air intercooler.



Engine control cubicle is located directly adjacent to the operating end of the engine. Cubicle mounts audible and visible alarms.

Paulding Adds Dual-Fuel Unit

Fuel and lube oil costs at Paulding, Ohio have been cut by $700 per month since the installation of its new engine.

by James J. Leslie, Superintendent
Paulding Light & Water Works

IN 1954, the town of Paulding, Ohio completed the installation of Engine No. 4. This was an Enterprise Model DQ-36, equipped for dual-fuel operation. Its installation has resulted in savings on fuel and lube oil costs alone, amounting to about $700 per month.

Aside from the lower operating costs resulting from the new engine, its 1000 kw gives the plant a good margin of safety during peaking periods. As a matter of fact, the DQ-36 can just about handle the peak load for the town on its own; but let's take a look back into the history of this plant. It will give a better idea of growth and also the reason for conversion from steam to diesel power.

Way Back

Municipal power in Paulding got its start during the steam era. Reciprocating steam engines, belted to generators, fulfilled the electrical requirements of the town. Water was pumped and street lighting provided at no cost to the taxpayer while electric rates continued to remain in line with those of the surrounding villages.

Along about 1936, however, electrical rates in the surrounding communities were lowered. Paulding followed suit only to discover that the income that resulted was not sufficient. In order to keep its rates at a point parallel to those of other communities in the area, the cost of power generation had to be lowered.

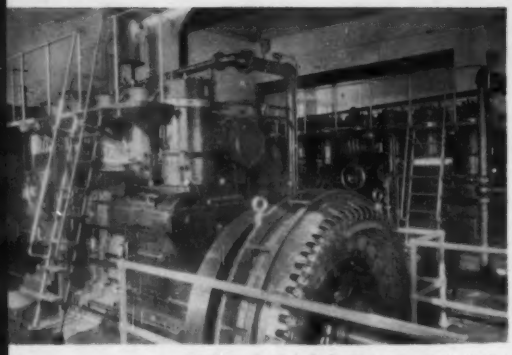
The city fathers decided to thoroughly investigate the matter and proceeded to visit all the municipal plants within a radius of several miles of Paulding. Operating figures from all these various plants which included steam, water, and diesel, were collected and tabulated. Also included were those plants which purchased power in bulk from local utility companies. The majority of the plants showed operating costs which were lower than those at Paulding.

After all the figures were compiled, the diesel proved to be the answer. It was a tough choice to make at first since many people were skeptical of the diesel and maintained that steam was the only power for the production of low-cost electrical energy. Further investigation into the diesel's economy led the town officials to the decision of installing a 400-kw diesel and to continue use of the steam plant.

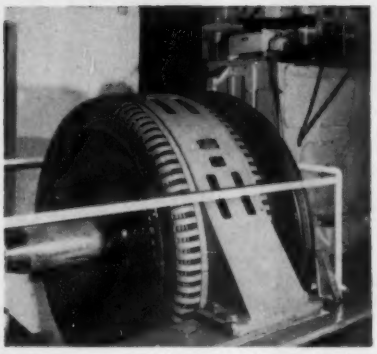
The first engine was a Fairbanks-Morse 5-cyl, 2-cycle engine rated 600 hp at 300 rpm. It was put on the line February 12, 1940. Bore and stroke for this unit was 16-in by 20-in respectively. By the following November, this first engine had generated nearly 100% of the power for Paulding. Town officials took a look at generating costs and decided to retire their steam plant and generate all power with diesels. Their choice of diesel power had been justified.

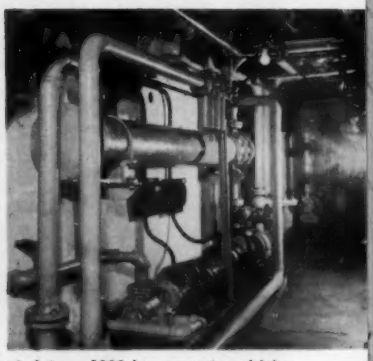
An engine similar to the first, except of seven cylinders and rated 840 hp at 300 rpm, was installed and on the line by May, 1941. It was at this time that Paulding celebrated its conversion from steam to diesel.

Several years later a third engine, another 840-hp



Engines 1 and 2 have seen many years of service at Paulding and are still used to carry the light loads.





The new engine is directly connected to a 1000-kw generator, driving it at 360 rpm. Lube oil cooler and "b & a" pumps shown at right.

F-M, was installed to meet the growing load demand and give the plant adequate capacity to handle future load increases. At the same time, sufficient standby power was needed to assure uninterrupted service during peaking periods in case one engine was down.

A while back with the peak load for the plant up to 1100 kw, the plant was again reaching a danger point since should one of the larger engines be out of service, the other two could not carry the load. Even if the smallest engine was down, the larger engines would be operating within a narrow margin of safety.

This meant another engine and after careful investigation and with the consideration that gas was available, it was decided that a dual-fuel engine would be chosen for the job. When the bids were opened and compared, Enterprise got the nod.

Design Details

The new Enterprise is also a 16-in bore by 20-in stroke engine. It has six cylinders and is of the 4-cycle, turbocharged, inline design, rated 1000 kw at 360 rpm. Simple and rugged, yet compact construction, is used throughout the engine.

Alloy steel through-bolts assure alignment of the bedplate and the single casing which makes up the crankcase and cylinder block and helps to relieve the block of tension stresses. Camshaft bearing supports are cast integral with the block. Large hand-hole covers provide easy access to all working parts.

A single billet is used in forging the crankshaft. After the crankshaft is machined to close tolerances, it is statically balanced and drilled for pressure lubrication of the main and connecting rod bearings. Crankshaft main and connecting rod bearings have large diameters to increase rigidity and at the same time lower unit bearing loads. The rear main bearing is provided with thrust faces which can bear against a crankshaft collar and the crankshaft or crank cheek.

Main, connecting rod, and camshaft bearings are all of the precision type and are all pressure lubricated. Connecting rods are drop-forged, fully machined, and rifle-drilled for lubrication of the bronze piston pin bushing. Cast crankpin boxes are separate from the connecting rod and are machined to the proper tolerance and then split for the insertion of the bronze-backed, precision-type bearings.

Pistons are of stiff-ribbed construction, use a full-floating piston pin, and are taper-ground. Eight compression rings are used. Oil rings are located one above and one below the piston pin area. Piston cooling is accomplished by the use of special passages. Cylinder liners are cast of iron alloy and are of the wet type. Leakage of cooling water into the crankcase is prevented by the use of two rubber seals located in the lower section of the cylinder block. Expansion of the liner is allowed for at the lower end.

Cylinder heads are iron alloy and have large water passages. Pressure-lubricated rocker arms which operate the intake, exhaust, and air starting valves, are mounted in the head and accessible by removal of the dust-proof cover. Zero-lash valve lifters automatically maintain proper contact between the valve stem and rocker arm and help to eliminate tappet noise.

In General

Auxiliary equipment is housed in the plant basement, which for the most part consists of the space between and around the engine foundations. This necessitates a compact installation, not only for the new engine but for the older engines as well.

In part, the dual-fuel engine has been integrated into some of the existing plant systems which are common to all engines. First, the fuel system. The fuel supply pump or transfer pump which takes fuel oil from the two 10,000-gal storage tanks, and the day tank booster pump both serve the new engines as well as the older units.

Second, the practice of circulating engine jacket water from the engine or engines on the line through the building for heat during the colder months has been extended to include the Enterprise engine. Jacket water from the operating engine or engines is also circulated through the water jackets of the engines not running.

This practice keeps engines ready to go on the line on short notice and also helps to reduce wear, hence lengthening the life of wearing parts.

A separate forced-draft cooling tower equipped with a 2-speed motor-driven fan is used for the new engine. This is located at the rear of the plant. Also located at the rear of the plant are the intake air filters and exhaust silencers for all engines.

The starting air system for the plant was installed when the plant got its first diesel. As would be expected, the system is both motor-driven and gasoline-engine-driven should dead plant starting become necessary.

Just below the operating end of the engine in the plant basement are the motor-driven before-and-after lube oil pump and the intercooler water circulating pump, along with the lube oil heat exchanger. Lube oil filters are located in the basement too, but along the side of the engine foundation.

Intake air for the Enterprise engine is taken through an oil-bath-type filter, through the turbocharger to the intercooler, and into the intake manifold on the engine. Adjacent to the operating end of the engine is the engine control cubicle which mounts the safety alarms, pyrometer, and gauges. Safety alarms are for high and low jacket water temperature, high and low lubricating oil pressure, and engine overspeed.

All engine and auxiliary equipment is maintained by plant personnel. Maintenance is set up on an hourly basis and adhered to. For the time being, preventive maintenance scheduling for the new engine follows the manufacturer's recommendations. Operating experience will dictate any adjustments in the schedule for the new engine. Lube oil from all engines is sampled on a 1500-hr basis by the lube oil supplier.

A Few Figures

During 1954 the new engine operated a total of 8040 hr and produced a total of 3,787,600 kwh. This is in contrast to the 1954 plant total of 4,061,400 kwh. Fuel consumed by the new engine during 1954 amounted to 35,811,000 cu ft of gas and 66,520 gal of diesel fuel oil. Under normal operation, the Enterprise engine is operated for 21 hr per day on gas and pilot oil and 3 hr on diesel fuel during light load periods.

For the same period, the other engines consumed 27,469 gal of diesel fuel oil to produce 273,800 kwh. Cost of the operation per kwh on diesel fuel oil was 0.00625 cents for the new engine as compared to 0.011 cents for the other engines. Operating on diesel fuel oil, the new engine generated 13.93 kwh per gal. Fuel costs to the town are 11 cents per gal for fuel oil and 58½ cents per thousand cu ft for gas.

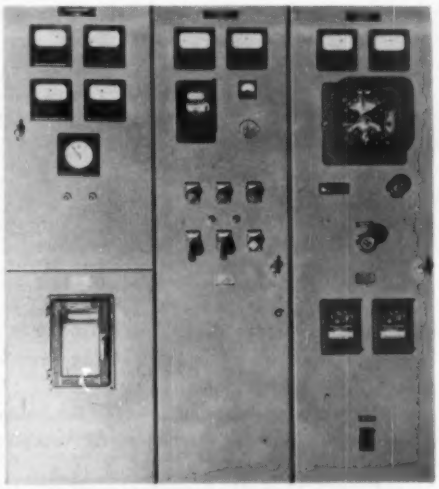
Summing Up

Today, electrical rates at Paulding are comparable with those of the surrounding areas. Street lighting, power for the City Hall and the swimming pool are provided at no cost to the taxpayers. During 1954, the street lighting load was 219,000 kwh and the City Hall consumed 16,100 kwh.

Additional street lighting facilities are presently being installed and more are planned for the future. This means future load demands on the plant will be greater, as will be increased demand from a new school which is also in the planning stages. Looking ahead, town officials are already thinking in terms of a second dual-fuel engine which, in addition to meeting future loads, will enable Paulding to take further advantage of lower cost fuel operation. Hence, increasing plant profits. The profits in turn will be used to pay for municipal improvements such as additional street lighting facilities, rebuilding of the entire distribution system, and when the time comes—another engine.

Principal Equipment for the New Engine

Engine	Enterprise Engine & Machinery Co.
Generator and Exciter	Ideal Electric Co.
Governor	Woodward Governor Co.
Turbocharger	Elliott Mfg. Co.
Intake Air Filter	Vortex
Exhaust Silencer	Maxim Silencer Co.
Cooling System	
Cooling Tower	Marley Co., Inc.
Pumps	Gould
Heat Exchanger	E. C. Cooley & Co.
Fuel System	
Gas Scrubber	Blaw Knox
Fuel Oil Tank Gauge	Liquidometer Corp.
Filters	Winslow Engineering Co. Cuno Engineering Corp.
Lube Oil System	
Lube	Cities Service Oil Co.
Filters	Winslow Engineering Co.
Pump	Geo. D. Roper Corp.
Mechanical Lubricator	Manzel
Switchgear	Ideal Electric Co.
Voltage Regulators	Allis-Chalmers Mfg. Co.
Pyrometer	Illinois Testing Laboratories Inc.

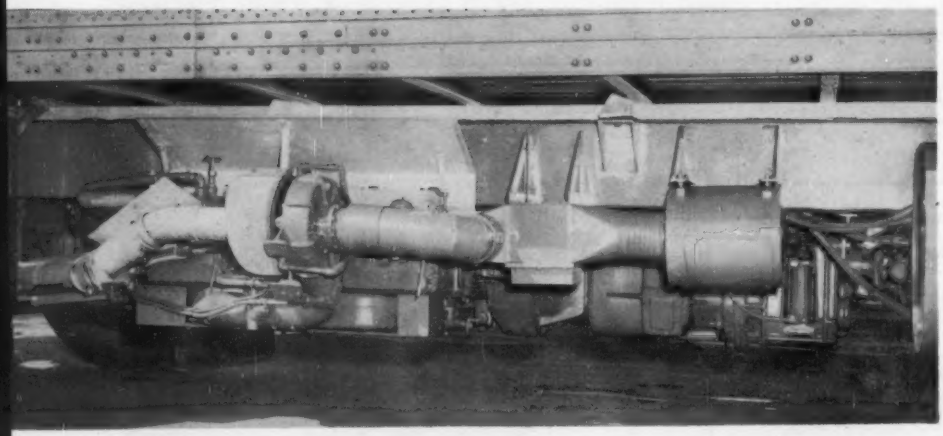


Switchboards similar to this one for the new engine, will be installed to serve the three older engines, adding to plant modernization.

Pacific Intermountain Express Company driver gives experimental XD-30 tractor a check after it's first run from Denver, Colorado to Oakland, Calif.

P·I·E Develops New Rig

Bigger payloads are the goal of every over-the-road trucker. This takes some doing though, if you're going to stay *legal*.



View of the engine mounting under the dromedary box. The box in the air system between the filter and the turbocharger houses the alternator rectifier, keeping it cool for a more constant flow of electricity.

PIE's experimental Model XD-30 tractor is perhaps the latest development in the trucking industry. It is the result of planning that started more than a year ago. Recent road tests indicate success for the prototype which was designed and constructed in the company's general shops in Denver.

According to A. K. Humphries, president of PIE, the management had some general ideas for a modified "dromedary" tractor. These were turned over to the firm's research and development section in Denver and the XD-30 is the result. The basic reason for the project was to allow more payload to ride in the tractor "dromedary hump" while keeping well within all legal limits of length, width, height, axle loadings, and gross weight for the states in which the XD-30 will operate. If tests continue to be successful, a contract will be let to a

qualified firm for the manufacture of the new units for use on PIE routes west of Denver.

There are three major features incorporated in the XD-30 which make it outstanding among today's trucking equipment. Probably the most distinguishing feature is the steering apparatus composed of two sets of front wheels on tandem axles. In steering the vehicle, all four front wheels turn. Drivers accompanying the unit from Denver said people stopped and stared when it went through a town. "They thought they were seeing double—and they were," one of the drivers said.

Another feature is the use of air suspension instead of the conventional steel springs. PIE last year equipped its entire fleet of van-type trailers with air springs—a move unheard of in the industry. Although this gave freight a considerably easier ride, the front of the trailers still rested on tractors equipped with steel springs. With the XD-30 equipped with air springs, the entire unit of tractor and trailer now "rides on air."

The third feature is the Cummins NHHT diesel "pancake" engine with turbocharger mounted underneath the "box" instead of up front under the driver. There are two main reasons for this flat-type engine. One, a technical matter of weight distribution and the other, its ease of accessibility for maintenance. The NHHT develops 235 hp.

According to Humphries, the XD-30 has added to the public's comfort and safety, and is considered a driver's dream. Both the public and the driver benefit from the combination turbocharger and exhaust system which cuts engine noise to a minimum. This system also, along with other features of engine design, practically eliminates black smog particles being emitted into the atmosphere.

From a safety standpoint the XD-30 has a full-vision wrap-around windshield. The windshield's height brings it well down below the driver's usual line of vision and allows him to look nearly straight down into the street ahead. For the driver, placing the engine amidships under the chassis has eliminated bothersome fumes and vibrations as well as making it quieter inside the cab. The design of the dual-steering axles make steering easier, also an additional safety factor.

Where the original PIE-designed dromedary carries 4000 lb of freight in its hump, the XD-30 will carry more than 10,000 lb. The old box was 11-ft, 6-in long and the new one 16-ft, 6-in. A feature of the experimental box is that it is insulated for transporting perishable products and thus becomes an adjunct to PIE's new fleet of 106 refrigerated trailers in that it can be used for less-than-trailer-load shipments. The XD-30 has a sealed opening where a mechanical refrigerator unit can be placed, or without this, dry ice may be used within the box itself. The box also has a new feature for PIE equipment—a side door for loading and unloading freight from the right side when required.

Work on the XD-30 has been under the direction of C. P. Palin, PIE manager of transportation and properties, with J. W. Riesing heading the Denver staff in detailed design and construction. Riesing praised the Denver personnel for the many ideas contributing to the eventual design of the XD-30 with L. H. Peterson heading the design group and L. G. Colburn the skilled mechanics who did the actual fabricating of the vehicle.

Another prototype tractor is now being built by an outside manufacturer designed for use on the same western routes as the XD-30. The two will be road-tested at the same time.

What Do You Know!

Here are some questions to test your general knowledge of the diesel field. Make your selections, then turn to Page 87 to check them.

1. Turbocharging high-speed diesels has which of the following effects on exhaust noise?
   a. None b. Louder c. Quieter

2. When locating engines in trucks, two of the major considerations are:
   a. Airflow requirements for cooling
   b. Optimum weight distribution
   c. Legal requirements
   d. Accessibility for maintenance

3. Two major trouble indications to monitor when engines operate unattended are:
   a. Adequacy of fuel supply
   b. Crankcase oil level
   c. Engine oil pressure
   d. Cooling water temperature
   e. Battery charging rate

4. One problem of applying turbochargers to the smaller variable-load and—speed engines is that being mechanically independent of the engine, there is no control of intake air volume or pressure.
   a. True b. False

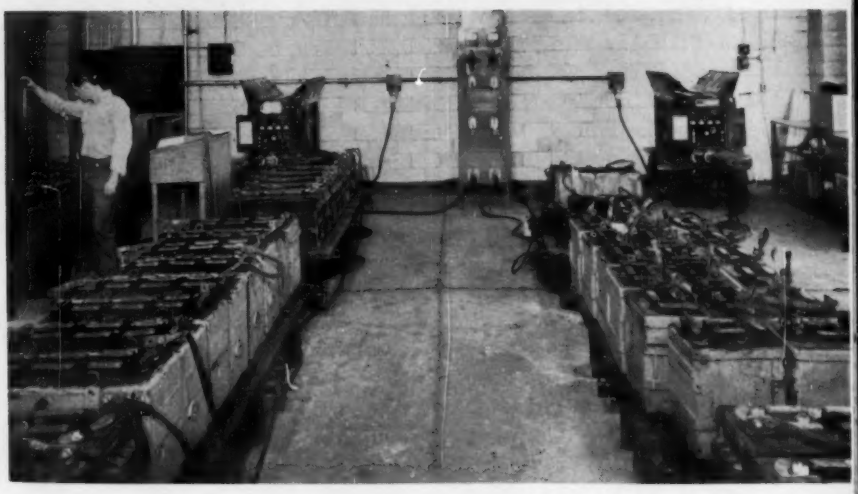
5. Maintenance records of turbocharged engines frequently show that with the higher output:
   a. Maintenance is higher
   b. Maintenance is lower
   c. Maintenance is the same

6. When cylinder head bolts are tightened to the proper maximum recommended torque in the proper sequence, the heads are correctly installed.
   a. True b. False

7. Three common reclamation methods—welding, plating, metal spraying—are used. Match up the three following repair items with the most appropriate process.
   a. Liners b. Press fits c. Valve seats

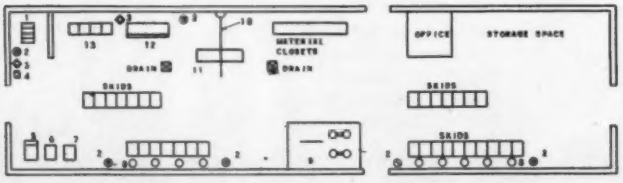
8. Specific gravity readings (corrected for cell temperature) indicate state of battery charge. Readings may vary somewhat from cell to cell. Indicate the maximum difference permissible before the battery is removed from service for repair.
   a. 10 points c. 30 points
   b. 20 points d. 40 points

Maintaining Batteries for Maximum Service



A discussion of proper battery maintenance techniques and the equipment required. If you have a large number of batteries to maintain, the following recommendations may save you money.

By E. P. Rush, Service Engineer
Exide Industrial Division
The Electric Storage Battery Company



Typical battery shop layout.
1. Wash pit
2. Water outlet
3. Air outlet
4. Steam outlet
5. Battery-powered hand truck
6. Test equipment
7. Movable electrolyte carboy table
8. Charging receptacles
9. Charging equipment room
10. Swing-boom hoist
11. Repair bench
12. Acid mixing tank
13. Carboys of electrolyte

MANUFACTURERS build more life into diesel batteries than many users get out of them. We find that diesel locomotive batteries last six to seven years on some railroads. On others, the same type Exide-Ironclad batteries average eight or more years in the same service.

Explanation? *Battery maintenance.* Railroads with good maintenance practices and battery repair shops make big savings on battery investments and avoid costly starting failures.

Suppose your road has a $1.5 million investment in batteries which last an average of 78 months. Your batteries cost you $19,200 per month. Then suppose you improve maintenance practices and lengthen average battery life by just one year. Battery cost drops to $16,700 a month, a monthly saving of $2500. The 12-mo extended battery life gives you a $30,000 saving on your present investment. Taxes and other factors might change this figure slightly, but the opportunity for saving is obvious.

Experience of some railroads shows proper maintenance can extend battery life even more than a year. By taking steps toward getting full life from your batteries you would get the biggest, most important saving of all - *cut down failures.*

Failures, the scourge of railway operations, mean costly interruptions of service. Frequent battery failures require a high inventory of replacements, and the expense of special handling for replacement and repair is abnormally high. Good battery maintenance can minimize failures and their high cost.

Routine battery maintenance takes but a few minutes. It can be done without additional personnel and actually saves time in the long run. Here are the three basic maintenance steps we recommend.

1. Inspect batteries at least once a week—read and record specific gravity and temperature of pilot cells in each half of battery, measure height of solution, examine tray blocking, see that wiring is in order and that all bolted connections are tight and free from corrosion, examine for electrolyte leakage, and be sure vent plugs are tight.

2. Every month do the regular weekly inspection, plus —check and record voltage regulator setting, add water and change pilot cells.

3. Twice a year, in addition to the regular weekly and monthly inspection steps, read and record specific gravity and height of solution of each cell and the temperature of pilot cells. Battery should be removed to battery shop if specific gravity of any cell reads 40 points or more

lower than highest reading cell, or if other repairs are required.

(*Exide Industrial Division has a sample record card available for railway use in battery maintenance.*)

Remember, a battery will let you know before it fails if you take the trouble to look. These steps will let you know what is wrong. Prompt action will cut down battery failures.

Battery Shop Layout

Good maintenance calls for a well-equipped, well-operated shop for testing and reconditioning. Out of our experience with railroads comes a good plan for setting up, outfitting and running such a shop. Here is the general outline. Use it as a guide. It is not meant to fulfill all individual requirements as equipment and methods will vary according to battery types and sizes.

Layout and equipment of the battery shop, as shown in the sketch, should be arranged so that batteries move progressively through stages of reconditioning, repair and test with minimum loss of motion, retracing of steps and manual handling. Provide good ventilation and adequate heat in winter months.

Charging equipment (No. 9 in sketch) must be selected so that voltage and capacity will take care of various types and sizes of batteries which will pass through the shop. We recommend sources of power between 100-v and 110-v for 32-cell batteries. Batteries with 56 or 57 cells may be split into two sets and charged from the 100-v or 110-v source. Generators to supply these voltages should be compound wound to maintain a regulation of plus-or-minus 3% or equipped with voltage regulators. Generator control panels should be equipped with fuses or circuit breakers, switches, ammeters and voltmeters.

Layout, design, and number of charging panels depend upon battery sizes and number of batteries to be reconditioned at one time. A variable charge resistor, have a 150-amp maximum capacity and about eight taps, generally covers the range needed. Each charging circuit should have a maximum current-carrying capacity in amperes equal to at least twice the finish rate of the largest size battery to be charged, and sufficient ohmage to reduce the smallest size battery to about half the finish rate. Resistors must be variable with taps and switching arrangements to cover the necessary charge range. Each charging panel should be equipped with an ammeter.

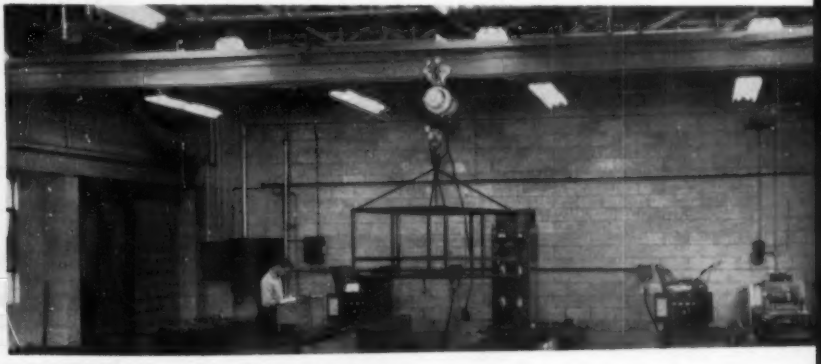
A "Hospital" circuit for charging individual cells or trays is also necessary. A special panel with variable resistor to take care of 1 to 16 cells may be used for this purpose.

A discharge outfit (No. 6 in sketch), which can be made portable by mounting on rubber-tired casters and equipped with discharge test volt-meters, is recommended for most shops. We had available a wiring diagram, resistor values and switching arrangement of a portable capacity tester on which a voltmeter may be mounted. If, however, stationary discharge resistors are used, a portable voltmeter table will be needed. One voltmeter having a large open-face 75-v scale and one voltmeter with a 3-v scale should be securely mounted within the table top so they can be read easily.

A steel work bench (No. 11 in sketch) should be secured to the floor and equipped with tray holddown facilities and electric power. Protect the top with a covering of wood, rubber, lead or other suitable acid-resistant material. A motor driven swing hoist (No. 10 in sketch) to rotate through an angle of 60 deg to 90 deg should be available to the work bench.

Acid of the gravity desired for adjusting specific gravity of batteries can be purchased in carboys (No. 13 in sketch). For most shops a transportable electrolyte carboy table (No. 7 in sketch) about 5-ft high is desirable.

The shop also needs a battery-powered electric hand truck (No. 5 in sketch) to handle battery trays and carboys. Skids shown in sketch are about 40-in x 50-in x 12-in, large enough to hold four average battery trays.



Batteries to be serviced are handled on wooden pallets by fork lift truck and overhead crane. The crane in right photo is equipped with hooks that attach to lifting eyes in four corners of the pallets.

Shop Practices and Procedures

Keep trays of each battery together in the shop as cells in lead batteries are designed to wear out together. In order to keep them properly balanced they should be of the same make, size, age and condition.

When the battery starts through the shop it first should be cleaned and inspected. This involves making sure vent plugs are tightly in place and parts are unbroken; thorough cleaning with bicarbonate of soda solution (1 lb per gal of water); reading and recording voltage, gravity and electrolyte level of all cells and pilot cell temperatures; and adding water to cells where necessary.

Next, give the battery a complete equalizing charge to determine full gravity of all cells. Acid or high gravity electrolyte should not be added to cells unless additional charging fails to restore normal gravity. Here is the order for giving the equalizing charge:

1. Place battery on charge at about twice the finishing rate or higher until voltage reaches 2.40 per cell or until cell or battery gasses freely.
2. Reduce charging to finish rate until gravity stops rising and stays at maximum for six hours. Meanwhile, take frequent voltage, hydrometer and temperature readings of pilot cells (highest and lowest gravity).
3. While still on charge at finish rate, record voltage and gravity of all cells and temperatures of pilot cells.
4. Correct hydrometer reading for temperature by adding 0.001 for each three degrees above 77°F and subtracting 0.001 for each three degrees below 77°F.

If at any time during the charge, electrolyte temperature exceeds 110°F or rises more than 15°F above room temperature, reduce the rate and lengthen charging time proportionately. The battery can be left on charge overnight unattended, but the rate must be reduced to one-half the finish rate to avoid high electrolyte temperatures.

If after the equalizing charge the specific gravity needs to be adjusted to normal, proceed as follows:

1. Put battery on charge at finish rate until all cells are gassing.
2. Draw off electrolyte from low reading cells down to splash covers. Never dump cells.
3. Slowly replace electrolyte of specific gravity not over 50 points higher than normal full charge gravity. Acid above 1300 never should be used for adjusting specific gravity.
4. Wait 15 minutes for added electrolyte to mix. Read specific gravity and repeat addition of electrolyte step as many times as necessary to restore gravity to normal.
5. Continue charge at finish rate for three additional hours, recording voltage of all cells prior to stopping.
6. Record gravity of all cells and electrolyte temperature of two or three cells after stopping charge.

If capacity of the battery is to be determined, a test may be conducted within 16 hours after completion of the equalizing charge or specific gravity adjustment. Before starting, the battery should be fully charged. Average electrolyte temperature should be between 70° and 95°F. Record hydrometer readings of each cell; record temperature and electrolyte level of two or three cells.

The battery may be discharged at the 3-hr or the 5-hr rate. Hold current constant during the discharge. After the rate has been reasonably stable for about five minutes, read and record voltage of all cells. Take periodic voltage readings of all cells and temperature readings of one or two cells during the discharge. Particular work schedules may vary the number of readings.

Stop discharge at 1.75-v per cell. Percentage of capacity is equal to the time in minutes the discharge has run, divided by the hour rate in minutes, and multiplied by 100.

$$\frac{\text{Discharge time in minutes}}{\text{Hour rate in minutes}} \times 100 = \text{Per cent capacity}$$

For example, assume discharge has run 5-hr and 15-min at a 5-hr rate. Substituting in formula:

$$\frac{315}{300} \times 100 = 105 \text{ per cent capacity}$$

If capacity is 80% or more the battery may be continued in service. Record specific gravity of each cell and temperature of two or three cells before recharging the battery.

Detailed instructions for replacing broken covers and jars or containers, another important function of the battery repair shop, are obtainable from Exide Industrial Division.

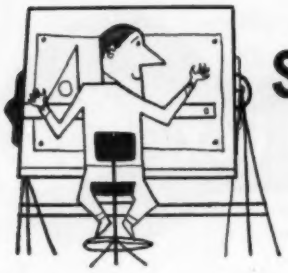
Before a battery is returned to service, connector bolt studs and all surfaces which are bolted together should be made clean and bright and coated with a protective grease or vaseline. All connectors should be made snug and tight. Clean off corrosion and neutralize with bicarbonate of soda solution. Wash vent plugs in water and inspect to see that gas escape openings are clear.

Warning—Gas formed while a battery is on charge is explosive, so keep flames and lighted cigarettes away!

This information on maintenance steps and the battery shop is a complete outline of diesel battery care. Use these ideas and get less failures, longer battery life and lower costs.

Tools and Materials Needed

- 1 cell filler
- 6 hydrometer syringes, spare floats and barrels
- 6 battery thermometers
- 3 sealing compound thermometers
- 2 separator inserters
- 2 seal nut wrenches
- 2 connector pullers
- 2 element pullers
- 2 putty knives
- Assorted screw drivers
- 2 post builders
- 1 portable electric drill
- 1 side cutting pliers
- 1 end cutting pliers
- 1 wire cable cutter
- 4 small steel wire brushes
- 2 center punches
- 1 lead burning outfit, including oxygen and acetylene or hydrogen gas tanks, torches and tips, and rubber hose
- 20 lbs. bar lead
- 1 thermostatically controlled 2-gal. electrically heated compound melting pot
- 1 electrical compound pouring ladle
- 2 8-oz. filling syringes
- 1 triangular scraper
- 50 short flexible cables with lugs for inter-tray connections
- 2 rubber electrolyte buckets
- 25 lbs. sealing compound
- 1 spool CSE caulking cord
- Solder wire and flux
- 1 keg bicarbonate of soda
- Carbon tetrachloride
- 1 can red paint
- 1 can black paint
- 25 lbs. cleaning rags
- Dark glasses for lead burning
- Rubber gloves



service section

Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you

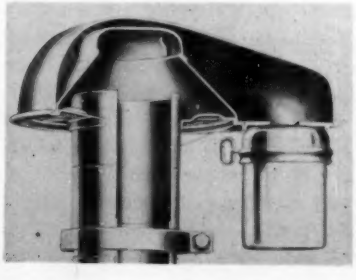
CATERPILLAR—Pre-cleaner Jars—All Engines . . .

For a number of years, a glass or plastic jar has been used on the oil bath air cleaners of many "Cat" diesel engines. The jar is connected to the pre-cleaner, which, as the name implies, pre-cleans the air before it enters the air cleaner. The pre-cleaner contains vanes which give a swirling motion to the air as it enters. Centrifugal force then causes the larger particles of dirt and dust to be thrown outward into the pre-cleaner jar. Minus the heavier particles, the air passes down the inlet pipe into the air cleaner.

What happens to the action of the pre-cleaner when the jar has been broken or for some unknown reason has been removed? Actually, if the jar is not replaced, the pre-cleaner might just as well be removed, since there will be no pre-cleaning action.

Without the jar, air will follow the path of least resistance and enter through the jar opening in addition to entering through the vanes. The larger particles of dirt will then go into the air cleaner oil cup and more frequent air cleaner maintenance will be required.

Some early "Cat" models were equipped with pre-cleaners using a glass, screw-in type jar. Should replacement of this jar be necessary, it



is available at the parts counter or the jar can be replaced with any screw-top fruit jar of the original size and with the same thread.

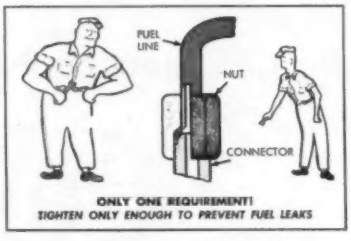
Later machines are equipped with a plastic jar which is clamped to the pre-cleaner rather than screwed into it. The plastic jar is very strong and resists shock and temperature changes. It is also available from the parts counter.

Keep the jar in place. Dirt is thrown into the jar by centrifugal force, it is not blown into the jar. Without the jar, the pre-cleaner is useless.

GM—Tightening Injector Fuel Lines—Series "51", "71" and "110" engines . . .

When installing injector fuel lines on Series "51", "71", and "110" engine units, it is recommended that the connections be tightened *only sufficiently to prevent fuel leakage.* This will prevent the flared end of the line from becoming twisted or fractured because of excessive tightening.

When all injector fuel lines are installed on an engine, the engine should be run for long enough to determine whether or not all connections are sufficiently tight. Should any connections be found to be leaking, *they should be tightened only enough to stop the leak.*



* * *

EMD—Injector Test Specifications—All Engines . . .

A change in our recommendations for testing injectors now makes it unnecessary to qualify injector tip leakage during any step of the injector test procedure.

Previously, leakage at the tip had been limited to the formation of a drop of fuel on the tip, provided it did not fall during the 35-sec "hold" test.

The revised recommendation permits leakage at the tip in any amount, providing the injector passes the 35-sec "hold" test. This test specifies that it should take longer than 35-sec for an applied fuel pressure on the injector to drop from 1000 psi, or valve opening pressure, (whichever is lower) to 400 psi.

Even at idle speed the injector operates at the rate of 4½ strokes per sec which does not allow time for a drop of fuel to form. It can be readily seen that the amount of leakage permitted under actual operating conditions will be very small and constitutes no danger to the engine.

In addition, test pressures for qualifying an injector are much higher than actual operating line pressures. This fact tends to magnify any slight leakage which might exist.

It is recommended that the holders of Engine Maintenance Manuals delete information pertaining to tip leakage qualifications. This is contained in Item 2 under section 6—"Holding Pressure Test" on page 1021-1022 of the 252 C manual and on page 1023 of the 4th edition 252B manual.

This change will be made in future editions of the manuals.

Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

Stuck Gasket Remedy

C. A. Bastian, West Allis, Wisconsin—I find many helpful items in your "Straight from the Tool Box" and would like to contribute a simple method which I have used for some time. I am sure it will reward anyone who wishes to try it.

Most of us have spent many hours scraping gasket material from head, block, manifold, and other surfaces. Next time you replace exhaust manifold gaskets, turbocharger gaskets, or any other gaskets which are subject to high temperatures (700 to 1100°F) during operation, coat both sides with a thin film of graphite and oil.

When it becomes necessary to remove the gasket treated in this manner again, you will find that it will fall away easily and it will not be necessary to scrape the gasket from the manifold or block faces. I have also found the graphite and oil mixture helpful when applied to capscrew or stud threads subject to high temperatures.

No doubt about it, the graphite and oil mixture will do the trick and save many man-hours on the end of a scraper to boot. In addition, there are a number of high-temperature greases that will do the job too. Many of these contain molybdenum disulfide (MoS_2) which has come into more common use. The characteristics of MoS_2 make it a natural for high-temperature applications such as manifold stud lubrication and so forth.—Ed.

Tool for Cat Injection Pumps

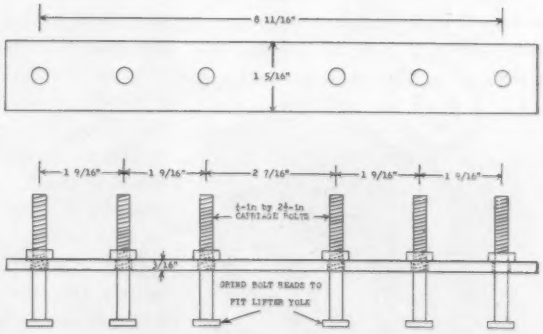
Walter A. Fredericks, Lacon, Illinois—Here is a tool, we have found useful in overhauling 6-cyl Caterpillar fuel injection pumps. Similar tools or jigs can probably be found in shops that specialize in the overhaul and repair of Caterpillar equipment, but we had to start from scratch.

The jig is used to lift the tappet assemblies, located in the injection pump housing, clear of the camshaft, when removal of the latter is necessary. The fixture consists simply of a piece of 1-5/16-in by 3/16-in flat steel stock about 10-in long and six ¼-in by 2½-in carriage bolts.

In drilling the plate, the holes, which are located directly over each tappet assembly, should be of sufficient size to allow adequate clearance for the ¼-in carriage bolts. The only work necessary on the bolts is to grind the heads so they fit into the yolk on the lifter assembly in the same manner as does the pump plunger.

When in place, with each bolt engaging a lifter yolk, when the bolts are tightened, the tappets will be raised and held clear of the camshaft, allowing removal of the latter component with no danger of injuring either the tappets or the shaft.

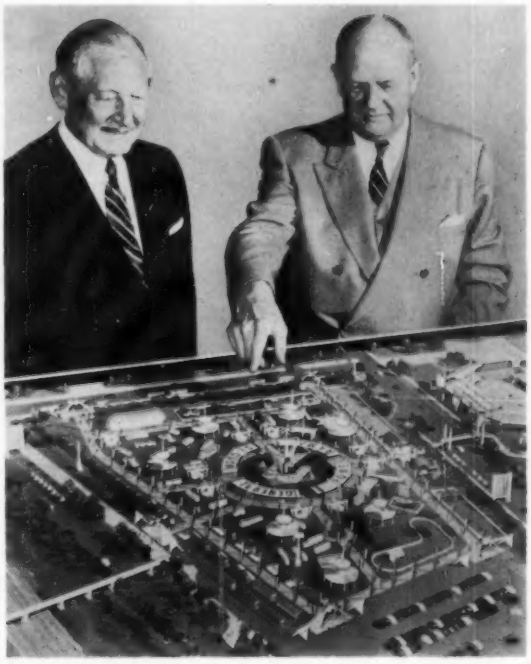
You are correct in the assumption that fixtures of this sort are in use in other shops. They are not however, common to every diesel repair shop, since their application is limited by the fact that the fuel injection pump's camshaft and tappet assemblies normally require servicing only at infrequent intervals.—Ed.



news of our industry

GM Sets Stage for Giant Power Show

To dramatically portray the contributions of diesel and aircraft power to America's industrial economy, General Motors Corp. has taken a 1-million-sq-ft area in Chicago's South Lake Shore Drive, adjacent to Soldier Field, to hold a spectacular outdoor exhibition. Shown here inspecting a scale model of the projected Powerama are GM's president Harlow H. Curtice (left), and C. R. Osborn, vice president in charge of the corporation's engine group.



The colorfully decorated, admission-free exposition, scheduled to run from August 31 through September 25, will demonstrate the latest in land, air, and marine equipment produced by the organization's divisions. It will also salute the production this year of GM's 100-millionth diesel horsepower.

Entertainment will range from song and dance stage shows presented four times daily to up-close exhibits of mechanical giants in actual operation. Visitors will also be welcomed aboard a varied number of marine craft arrayed along a specially-built pier in a protected lagoon. These will include a U.S. Navy submarine, a pleasure launch, and a shrimp boat.

Top features of the exhibits will be: the "world's largest dump truck"; an M-48 tank with inside-out control apparatus to enable full viewing of control operation; a full-scale model of a vertical rising aircraft showing straight-up takeoff; an F-89 Scorpion fighter plane; an operating oil drilling rig; a working saw mill cutting up timber; a cotton gin in operation; a high-speed diesel locomotive with engine running under visitors' operation; a full-scale display of roadbuilding operations; and a GM diesel engine used in "the world's fastest submarine".

Other exhibitions will include the latest developments in diesel-power transportation; plowing demonstrations; earthmoving demonstrations, and numerous engines and cutaways. GM's experimental gas turbine automobile, the XP-21 Firebird, will also be on view, plus the seven experimental "dream cars and trucks" exhibited at GM's recent motorama. And Frigidaire's "Kitchen of Tomorrow" will give an additional view of the future.

GM divisions partaking in the Powerama will include Allison, Cleveland Diesel, Detroit Diesel, Diesel Equipment, Electro-Motive, Euclid, and GMC Truck & Coach.

new products . . . . . Page 66

new literature . . . . . Page 70

organizational news . . . . Page 72

new safety solvent

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news of our industry

Baldwin Exhibits German Diesel

At a recent press conference, Baldwin-Lima-Hamilton Corp., officials displayed a prototype diesel engine, designed by the German firm of Maybach-Motorenbau Co., on which Baldwin has been licensed to build. The company will build three power units of 1000 hp each, compared with the exhibited 400-hp German model which is a switching engine.

The new engines will be placed in specially-built locomotives, about half the weight of conventionals. They will be operated by mechanical drive and will be used to haul new-type, low-slung, lightweight passenger trains for the New Haven and New York Central railroads, at speeds up to 120 mph. Delivery is planned for next spring.

For comparison purposes, a sketch of a 9200-lb Maybach diesel was also exhibited, superimposed on a sketch of a conventional 30,200-lb Baldwin. It covered less than half the space of the Baldwin, though both were said to develop about 1350 hp. In addition, Baldwin spokesmen claimed fuel savings will run up to 50% above the heavier conventional locomotives which weigh about 250,000 lb compared to the new unit's 135,000 lb.

As a cost-saving feature, the entire unit will be seated on its own trucks to give packaged maintenance. The housing of the locomotive will be capable of lifting off, the engine detached, and a new unit installed in about 4 hr. This was compared to replacement of power units on conventional locomotives, which are said to require two days. (Budd's hydraulic-transmission RDCs are currently operating on a similar design of easy maintenance.)

Baldwin's current production diesel has 12 cyl, although Maybach is now designing a 20-cyl unit with an estimated 2700-3000 hp. Four forward gears and one reverse will be employed. The new locomotives will measure 11-ft high, and 46-ft long.

The New York Central has ordered one unit to haul a 9-car lightweight train which is being built by Pullman-Standard Car Mfg. Co. The two units New Haven has ordered will be used at each end of a similar-length train to enable quick reversal.

Federal-Mogul Consolidation

Directors of Federal-Mogul Corp. and Bower Roller Bearing Co. have voted to submit a merger plan to their respective companies. Under the agreement, Federal-Mogul will change its name to Federal-Mogul-Bower Bearings, Inc.

F-M has been distributing Bower products since 1950. About a year ago it took over the Bearings Co. of America, and with its new addition it will now be able to offer a complete line of bearings. The business of each merged company will be carried on in separate divisions. The plan also includes the closing of F-M's Detroit plant and the 50% enlarging of its service parts warehouse in Coldwater, Mich.

Daimler-Benz Sets Up U.S. Unit

The German firm of Daimler-Benz A.G. has announced the creation of an American subsidiary, Daimler-Benz of North America, Inc. The company, world-famous for its high-powered Mercedes-Benz sports cars, bases it main business chiefly on heavy diesel-powered vehicles.

Preliminary indications are that American diesel truck production will probably begin this year, although the site of the new plant was not revealed. The operation will be on a manufacturing-assembly basis with some importation of parts. Later production plans call for the manufacture of tractors, specialized diesel engines, and other diesel-powered products.

Negotiations were also revealed to be underway with prospective American partners for establishment of a service organization and for an additional operation in Canada. Generally, it was stated, the company will seek markets falling between the heaviest types of diesel trucks, such as those that haul lumber, and the lighter gasoline-powered trucks.

news of our industry

DEMA Meets at Young Radiator

A 1-day educational meeting of the Diesel Engine Manufacturers Assn. was recently held at the Racine, Wis. plant of Young Radiator Co., with more than 85 diesel engine manufacturers, university professors, and industrial engineers in attendance.

The program began with conducted tours through the main plant to show fabricating, assembly, and general manufacturing operations. It concluded with technical sessions concerning various phases of heat transfer, conducted by company engineers. Subjects discussed were radiators for small, high-speed, and heavy-duty vehicles; radiators for stationary large horsepower diesel applications; and shell and tube heat exchangers and cooling industrial hydraulic circuits.

De Laval Expansion Program

On the anniversary of its founding 54 years ago, De Laval Steam Turbine Co. announced extensive plans for expansion. They involve an increase to existing manufacturing plants in Trenton, N. J., another new sales and service building in Forrest Park, Ill., a new sales and service plant in Millbrae, Cal., and a new sales and service structure in Houston, Tex.

The program is the outcome of a major survey begun by the organization in 1953. De Laval recently introduced a centrifugal compressor for natural gas pipelines and a high-pressure turbocharger for diesel and gas engines. It is also introducing a marine reverse-reduction gear unit. Many sales outlets have been added in South and Central America and the company is now represented in 26 foreign countries.

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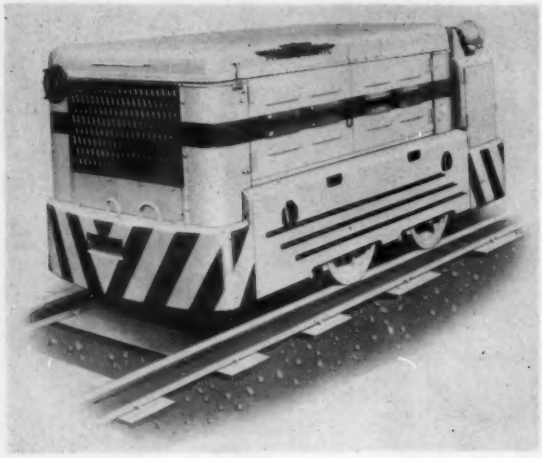


Mine Locomotive

Plymouth Locomotive Works, a Division of The Fate-Root-Health Company has announced a new line of mine locomotives to be called the Plymouth Mine-O-Motive. The Mine-O-Motive is offered in sizes from 5 to 10 tons and will eventually include a 2-ton trammer.

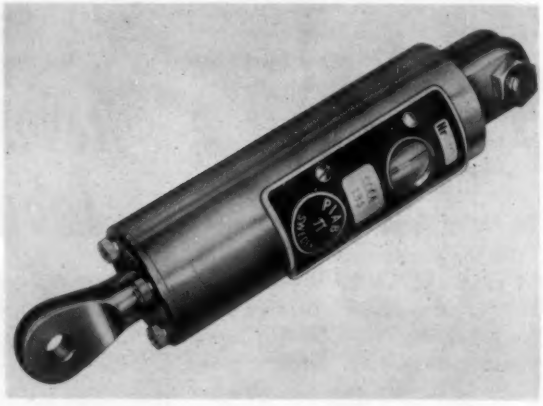
The series includes a "Permissable" model fully tested and approved by the U. S. Bureau of Mines under Schedule 22 for underground operation in coal mines. Other models have been operating in non-gaseous mines for many years. Suitable scrubbers and exhaust conditioners are offered on all models along with diesel-torque converter drive.

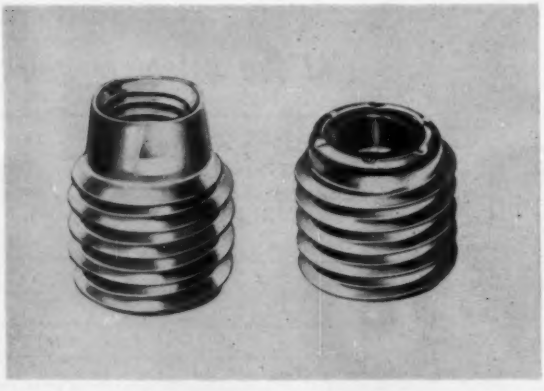
Also included in the Plymouth locomotive line are diesel-electrics from 25 to 50 tons and other models with diesel power and either mechanical or torque-converter drive. Details are available from the company.

Dynamometer

Called the PIAB dynamometer, this Swedish-made instrument is now available in the United States and Canada, according to a recent announcement of The Walpole Company. Accuracy is retained in the basic construction principle—the use of annular conical springs of high compressibility, designed to have long life due to short pull rod movement. The measuring indicator dial is supported on anti-friction bearings.

The dynamometer, reportedly in use throughout Europe for some time is available in capacities from 500 to 80,000 lb. Mechanism and dial are totally enclosed, making it dust-tight and water-tight. Built-in dampers guard against instrument damage from varying impulse loads. Detailed information is available from the company at 419 Boylston St., Boston 16, Mass.





Self-Locking Bushing

Latest addition to the line of self-locking fasteners currently being manufactured and marketed by the Elastic Stop Nut Corporation of America is the Type 2424 self-locking bushing. It is available in two designs as shown in the accompanying illustration. The Type 2424, shown on the right-hand side, has a red nylon locking collar and is recommended for use where operation temperatures do not exceed 250°F. The Type LH2424, shown on the left side incorporates an all-metal locking feature. This device is recommended for use in a higher-temperature range or between 250°F and 550°F. Further information and prices on the self-locking fasteners and bushings are available from the Elastic Stop Nut Corporation of America, 2330 Vauxhill Road, Union, N. J.

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The full Standard Set of these powerful tools, pictured below, will give your crew the *right* equipment to break loose those big, rusted-on nuts and bolts, or to tighten them up to the limit . . . with no time-wasting makeshifts. There are many more shop-proved Snap-on tools that will save money in your plant—more than 4,000 to meet the widest range of needs. Snap-on gives you close-at-hand service through factory branch warehouses in principal industrial centers. Write for the Snap-on Special Industrial Catalog and 104-page General Catalog.

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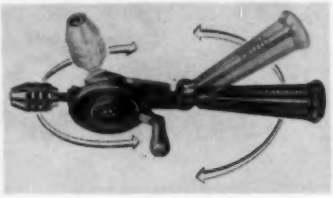

All-Angle Drill

To solve difficult drilling problems, Plomb Tool Co., Los Angeles 54, Cal., announces the Proto No. 370 all-angle drill whose chuck and handle are both adjustable to various angles. This allows the drill to reach around obstructions, work close to floors and walls, and operate in close quarters.

Up to ¼-in capacity, the chuck swings in a 270-deg arc, and has a spring lock that enables change of angle with a flick of the thumb. The handle turns in a 180-deg arc at right angles to the chuck movement path and is held in position by an adjusting screw. Storage space for a large number of regular and high-speed drills is provided in the interior of the hollow handle.

Small Shaft Coupling

Priced to put it in competition with chain, pin-and-bushing, and flexible disc or grid-type couplings, commonly used for medium- to heavy-duty service between small shafts, is a medium-duty coupling of the gear type, now being manufactured by Sier-Bath Gear & Pump Co., Inc., 9252 Hudson Blvd., North Bergen, N. J. It has a 1-piece smooth sleeve, and the sleeve and hubs are made of powdered steel. Among claimed advantages are positive gear drive, higher hp capacity, higher speeds, less maintenance, and longer service life.

One size only is available, to accommodate shafts from ½ in to 1¼ in. Made in a 7-parts design, the seals are Neoprene; snap rings are spring steel to withstand 50,000-lb end thrust; and hubs and sleeve are said to have tensile strength of 35,000 psi. The smooth exterior after assembly is claimed as safe as smooth shafting.

. . . LOCOMOTIVE PARTS

(*Continued from Page 49*)

The furnace rests on 9-in legs, which makes its top 26-in above floor level, a convenient height for operator. This furnace has four burners, one located at each corner, so arranged that burners do not have to be removed when furnace is lifted out of the stand and set aside for cooling.

Natural gas is the fuel and air is furnished by a blower. Each furnace is controlled for proper heat. The temperature is brought up to 500°F in the first hour. The pyrometer is then set for 900°F for the second hour, then to 1400°F for the third hour. At the end of three the heat is turned off, and carbon plugs are inserted in the valve seat holes. Welding is done with a No. 10 tip in a light weight torch, with 14-psi acetylene gas and 18-psi oxygen. Welding wire recommended is ¼-in No. 10 Moly cast iron rod.

After welding the lid is completely covered with asbestos sheeting and head allowed to cool for 30 hr in the furnace. The cooled head is rough machined in the valve seat area on a boring mill, then the valve seats are rough machined on a drill press using a pilot fly cutter.

The head is hydrostatically tested again, and if no leaks appear it is finished machined. The latter is done on a boring mill on which the valve seat area is machined to new dimensions. Seats are then finished bored and reamed with a floating reamer on a drill press. In this operation a new valve guide and a dial indicator are used to determine standard tolerances. The next step is a surface grinder where the other side of the head is squared.

Removal of the old injector sleeve and application of a new sleeve is next. The old sleeve was left in the head so the hole would not carbon-up in the welding process.

A final test for leaks is made, following which the joint is lapped in, and final grinding of valves to seats is done. Assembly follows as the last step.

Summing Up

Railroad mechanical department officers know that the adoption of reclamation and repair standards is desirable and urgent from an economical standpoint. Some locomotive components required repair procedures rather early in the life of the first locomotives, and some practices have been proven sound by millions of miles of satisfactory road operation. Methods followed in these instances can be safely adopted as standard.

But many other parts repaired by the best procedure known at the time have not yet been proven by long service. The volume of work requiring reconditioning grows rapidly and some means other than millions of miles of endurance testing is needed.

The best approach seems to be through metallurgical knowledge and the experience of competent test and research departments on many railroads. The closer cooperation of the shop organizations, and the assistance of the locomotive builders' personnel counts too.

it pays to know the EXACT RPM of your DIESEL ENGINE!

Get maximum efficiency
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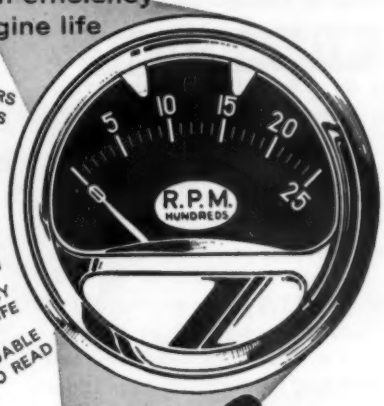

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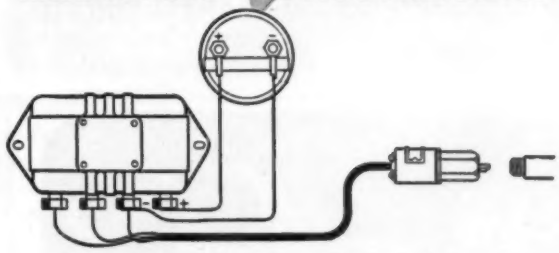

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new literature

Fuels in Storage

A Naval research laboratory report just made available to industry by the Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C., indicates that measurements of the scattering of light by gum particles in diesel fuels may become an effective way of predicting fuel behavior in extended storage.

Gradual formation of insoluble gum is said to be the element of fuel instability considered most undesirable. The laboratory anticipated that this gum would first appear as submicroscopic suspended particles. It was reasoned that because of the ability of small particles to scatter light, a technique based on this principle would detect incipient gum formation before it becomes evident by other means. A photometer was built for the study and is described in the report.

Research demonstrated that marked changes could be observed in presumably unstable fuels by the method when the fuels were only a few days old. In addition, data was obtained on the effect of two stability additives to show that fuels containing these additives, on aging, develop less light scattering than fuels without the additives. This indicates that the method will be useful in investigation of stability additives.

Railroad Service Equipment

The Nolan Co., Bowerston, Ohio, has prepared a catalog of its service products for railroads and general industry. Pictures, specifications, and details are given of bumping posts, portable derails, car blocks, car stops, blue flags, rail skates, track dollies, tool and supply cars, rerailers, lifts, hand trucks, and a new all-purpose loader.

Simplified Drafting

Eleven rules for simplifying drafting practices are contained in a 36-page book put out by American Machine & Foundry Co., 511 Fifth Ave., New York 17, N. Y. Through the medium of sample drawings of engineered parts and assemblies, the use of word descriptions for simple parts, and free-hand drawings, the rules are illustrated and compared with traditional methods. The new methods are declared to result in a 50% reduction in hours required to complete a given volume of work.

Water Softeners

Troubles caused by hard water and economies effected by curing them are discussed in a 20-page bulletin released by The Permutit Co., 330 W. 42 St., New York 36, N. Y. Among the uses of softened water dealt with in the booklet is one for the makeup in cooling systems of diesel engines. Specifications, operating characteristics, and typical installation photographs of the water conditioning systems are included.

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STATIONARY & MARINE

HEAVY DUTY POWER

Diesel • Dual Fuel • Tri-Fuel • Spark Ignited Gas

Units from 73 to 6933 HP
48 to 5007 KW

Over a million horsepower at work the world over!

ENTERPRISE
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Since 1907

PARK

The Symbol For

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DIE FORGINGS

DIESEL CRANKSHAFTS
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Weighing Up to 4,000 Lbs.

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For POSITIVE LUBRICATION
It Pays to Specify
TUTHILL PUMPS
For dependable lubrication of diesel engines and power units, Tuthill offers a complete line of positive displacement pumps, designed for lubricating and scavenging. Included are automatic reversing pumps and stripped models for built-in applications.
Write for the Tuthill Pump Guide listing all Tuthill Pumps for lubricating requirements. Send specifications for quotation.
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KIENE®
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gives compression and firing pressures faster
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The Model K-100 Kiene Pressure Indicator accurately measures compression and firing pressures — assures the proper maintenance of diesel engines — helps prevent costly down time. Only one moving part — no friction or inertia effects — no complicated adjustments.
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new literature

Specifications of Lubricants

In its technical booklet, *Lubrication*, The Texas Co., 135 E. 42 St., New York 17, N. Y., has published an article which discusses some of the pitfalls of non-standard purchase specifications applied to petroleum products. It explains how this can operate to the disadvantage of the purchaser and the discouragement of the supplier.

The solution offered is closer cooperation among the equipment manufacturer, consumer, and lubricant supplier. With increasing knowledge of lubrication, this is expected to occur. However, until such a time arrives, the user is given a recommended practice. He is urged to establish specifications for basic requirements of the lubricant and then to discuss standards of performance expected with his supplier.

The classifications of lubricants by various societies are given as a good example of results obtained from mutual cooperation.

Dynamometer Test Procedure

Complete dynamometer diagnosis and adjustment procedure for Cummins diesel-powered trucks has been published jointly by the service training divisions of Clayton Mfg. Co. and Cummins Engine Co. The book offers many valuable aids in obtaining maximum horsepower and minimum fuel consumption.

Three main subjects covered are checking road horsepower, checking ailments or performance complaints, and making routine inspections. For a copy, request Form C-566 from Clayton Mfg. Co., Box 550, El Monte, Cal.

MoS_2 for Threaded Connections

The Alpha Corp., 65 Harvard Ave., Stamford, Conn., has published a test report on the use of its Molykote lubricant for highly loaded threaded connections. Called Field Report No. 141, it details comparison tests between its Type G paste and other thread lubricants at room and elevated temperatures.

Tests covered the effects of the lube on bolt tension, of galling in the threads and below the nut, of repeated tightening on bolt tension; and determination of the coefficient of friction. Tables of curves illustrate the results obtained.

Cooling Water Control

Sarco Co., Inc., 350 Fifth Ave., New York 1, N. Y., has released a detailed bulletin on its new self-powered T44 cooling control which controls cooling water temperature in jackets or coils of equipment such as compressors, oil coolers, condensers, and stills. It includes design features, operation data, construction details, capacities, and temperature adjustment ranges. In addition, typical hook-up sketches are given.

Pipe Friction Manual

The Hydraulic Institute, 122 E. 42 St., New York 17, N. Y., has published a pipe friction manual presenting latest available information on the subject. Complete with formulas, graphs, charts, diagrams, and tables, the manual sells for $1.75.

organizational news

Alco Diesel Product Manager

Richard B. Fairman has advanced to the post of product manager of stationary and marine diesel engines at Alco Products, Inc. His career with the company dates from 1946 when he joined the diesel engine sales training program. He worked as a sales representative until 1955 and was then assigned as supervisor of stationary and marine engine parts sales, becoming northeast regional renewal parts manager later in the year. In 1953 he moved up as assistant to the manager of renewal parts for operations and in 1954, he was appointed assistant manager of stationary diesel engines.

Richard B. Fairman

Petter Expands Southern Sales

Two new distributors have been appointed to represent the Petter Diesel Engine Div. of Brush Aboe, Inc. in Florida as part of its plan to set up a wider network of distribution in the southeastern states.

Neff Machinery, Inc., Miami, will concentrate on sales of industrial engines and Southern Diesel Sales, Fort Myers, will cover the marine range. Both will carry substantial stocks of engines and parts as well as small generating sets.

Stanley Appoints Associate

Stanley Engineering Co. announces it has advanced Roy F. Vanek to the position of associate. He will continue his responsibilities with power projects throughout the Midwest, but will also assist in administering company activities.

Mr. Vanek has been on the engineering staff of the consulting engineer firm since 1950. Before that he had 20 years of professional engineering experience.

Roy F. Vanek

AMOT SAFETY CONTROL

AMOT Model 1476-47 automatically shuts down engine on high water temperature or low lube oil pressure. Features are:

1. **No capillary tube and bulb used.**
2. **Uses well known AMOT element.**
3. **Several temperature sensing units can be used with one control unit.**
4. **Will operate an air whistle.**
5. **Will operate a diaphragm gas valve for large gas engine shut down.**
6. **Will operate as a diesel fuel shut off valve.**
7. **Available with 2" direct connected gas valve.**

AMOT CONTROLS CORPORATION

RICHMOND 1, CALIFORNIA

BOOST HORSEPOWER

50% or more

WITH MIEHLE-DEXTER SUPERCHARGERS

- **For Internal Combustion Engines**
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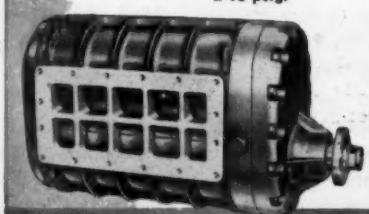
- **100-750 H.P., 15-4000 cfm., 2-15 psig.**



MIEHLE-DEXTER SUPERCHARGER

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SYNCHRO-START safety alarm panels, such as installed in the three engines of the ALLIED-ASHLAND or her sister ship the AETNA-LOUISVILLE, are the first choice of engineers for application where only the very best of equipment is acceptable.

Safety alarm and shut-down panels are available which provide protection against practically any abnormal condition of the engine and its associated equipment.

These systems provide automatic starting-stopping and safety protection of engines which are being used for every conceivable power application. Each control set is made to best fit the installation for which it is to be used.

Our Engineering Department will gladly make recommendations to meet your specifications and send you our complete catalog describing our equipment.

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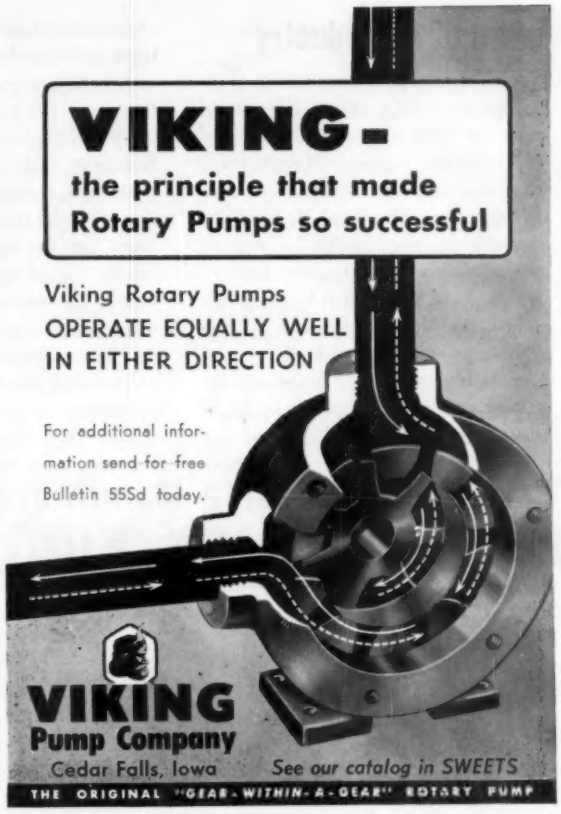


organizational news

B-L-H Elections

McLure Kelley has become the new president of Baldwin-Lima-Hamilton Corp. He succeeds Marvin W. Smith who will continue as an officer of the company in the position of chairman of the executive committee. Mr. Kelley, former president of Austin-Western Co., has been executive vice president of B-L-H since the first of the year.

Other executive positions have been given to Robert G. Tabors, former assistant general manager of the Hamilton Div., and Albert Clements, former vice president of the Clearing Machine Corp. They are both now vice presidents of the Hamilton Div.

Clark Field Manager

Clark Equipment Co. has established a field office in Tulsa, Okla. to provide sales, parts, and service facilities for its automotive line. Wade A. Eskridge has been placed as manager of the office. He is a mechanical engineer with experience in automotive components and became associated with the company last year. His territory will include Oklahoma, Texas, Colorado, Missouri, Arkansas, Louisiana, and part of New Mexico and Tennessee.

Enterprise Adds Managers

Recent appointments at the Enterprise Engine & Machinery Co. have been extended to Michael E. Conway, Robert M. Pearson, and L. C. Michie.

M. E. Conway

R. M. Pearson

L. C. Michie

Mr. Conway has joined the company as advertising manager, leaving that same post at Pacific Car. He has also served as president of the Western Washington Chapter of the National Industrial Advertisers Assn., and as vice president of the Navy League.

Mr. Pearson, active in the diesel engine industry for 30 years, has come to the company as San Francisco field sales manager. He was most recently manager of sales at National Supply Co. and previous to that was associated with Fairbanks Morse & Co. and General Motors Corp.

Mr. Michie, in his new association with the company, will occupy the post of St. Louis district manager. He was previously with the diesel service division of Baldwin Locomotive Works for 10 years and spent another 10 with Fanrbanks, Morse & Co. as a service supervisor and diesel engine sales engineer.

news of our industry

New Industrial Diesel Lube

To replace its standard HD line of lubes for stationary industrial diesel and dual-fuel engines, Standard Oil Co. (Ind.) reveals it will begin distributing Stanodiesel Oil M. It will be available in No. 10, 20, 30, and 40 grades, with all requirements for former grade 45 to be filled by grade 40.

The new lube represents an upgrading to meet demands of new engine designs and the more severe operating conditions imposed by higher average loads and increased use of economy fuels. These latter conditions have tended toward higher engine wear and greater deposit formation.

The oil conforms to Military Specifications MIL-L-2104A and incorporates a detergent-dispersant additive and oxidation inhibitors. Antifoam agents included are said to render the oil suitable for use in hydraulic governors, and addition of a special wetting agent is claimed to enable maintenance of film on areas of reduced clearance and extreme pressures.

The result of the improvements is expected to be cleaner crankcases, pistons, cylinder walls, and other engine parts. Laboratory tests, it is stated, has shown reduced combustion chamber ash deposits in natural gas and LPG operation, and field tests have disclosed the elimination of fuel injector and pump sticking resulting from deposits caused where fuel and lubricating oil commingle.

The World's Leading Manufacturers of
FUEL INJECTION EQUIPMENT
for
Diesel
Engines

DEPOTS AND
SERVICE AGENTS
IN OVER
100 COUNTRIES

C.A.V.

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., 653 TENTH AV., NEW YORK 36, N.Y.
Sales Office: 14820 DETROIT AVENUE, CLEVELAND 7, OHIO.

AP174-715.

Cummins Steps Up Diesel Output

For the second time in recent months, Cummins Engine Co., Inc. is increasing its production of high-speed, lightweight diesel engines by another 17%. In making the announcement, C. R. Boll, sales vice president, stated the increase has been necessitated by the highest rate of orders in the company's 36-year history. He indicated one contributing factor as the introduction of five new diesel models for construction, automotive, and industrial applications.

According to Mr. Boll, demand for diesels by the trucking industry also continues at a high level. Recent truck registration figures, he stated, "show that Cummins diesels powered more than 50% of all diesel on-highway trucks purchased in the U.S. during 1954." He revealed that the company intends to hold this leadership by further product advances and more service locations.

Borg-Warner Acquisition

Shareholders of Borg-Warner Corp. and Byron Jackson Co. have been asked to agree to a merger of the two companies. The merger is expected to give additional diversification to Borg-Warner's growing fields of activity, especially in the oil field equipment industry where Byron has specialized.

GM Training School in Mexico

To provide instruction in the proper operation and maintenance of its products, Detroit Diesel Div. of General Motors Corp. has established a service training center in Mexico City similar to those it conducts in the U.S. A mobile on-the-job training unit has been operating in Mexico for the past three years.

news of our industry

India Stamps Tractor

To characterize its 5-year plan for the building up of India, the Posts and Telegraphs Dept. of that country has issued an 18-stamp series depicting its peoples' industrial efforts. A Caterpillar D4 tractor pulling a plow, is featured on the lowest denomination of the series.

This is the second definite series of postage stamps brought out by India since its independence, and the second time that a Caterpillar tractor has been commemorated on a nation's stamp. In 1954, the Bahamas issued a 1-penny stamp which reproduced a D8.

Denver-Chicago Adds Diesels

To achieve maximum payload per trip, Denver-Chicago Trucking Co., Inc., has modernized its coast-to-coast service with the acquisition of 60 lightweight cab-beside-engine trucks. They are Kenworth Model 522 tractors, powered by 200-hp Cummins diesels.

The models are engineered for driver safety, comfort, and visibility. Improvements in engine accessibility and ease of maintenance are other features. The order resulted from the success of a trial program the firm staged several years ago when it ordered Kenworth diesel-powered tractors for through-sleeper service.

Highway Building Costs Drop

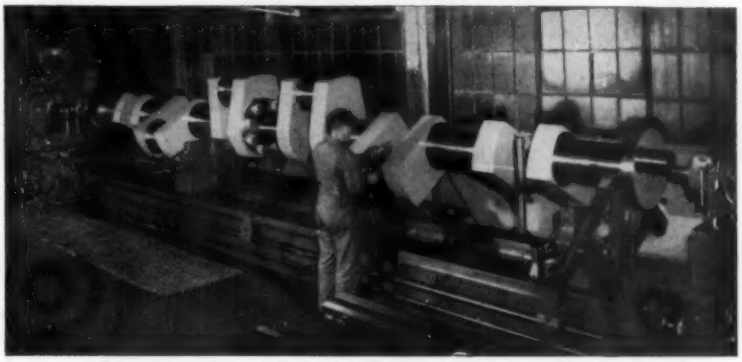
The growing use of motor graders, scrapers, pavers, ditchers, spreaders, and other units has transformed highway construction operations, according to the American Petroleum Institute. This is illustrated by the fact that 78,000 job site employees are performing the same amount of road-building that required 125,000 workers just seven years ago. Byproducts are increased efficiency and dollar savings, although the price of most materials such as steel and concrete have increased in this period.

The counterbalance is the result of a sharp drop in excavation cost, a major item in construction, primarily due to the tremendous productivity increase of earthmoving equipment. Accelerated mechanization is also creating keener competition among road contractors, evidenced by twice the number of bids submitted per project in 1954 than the year before.

Studies also showed that bids averaged about 11% below engineering estimates, with savings running higher in many cases. Wisconsin, for example, reports that contract prices dropped about 18% during 1954, with bids this year in some instances still falling below state engineers' estimates.

The use of mechanized equipment was most effective in construction of more costly and heavily traveled trunk routes. For example, low bids on the Indiana toll road have already saved the state $18 million and may run as high as $35 million. Original estimates of $508 million for the proposed Ohio turnpike may run to only $448 million. Good grounds for anticipating continued progress is reported.

DIESEL CRANKSHAFT REPAIRING AND REFINISHING



The above shaft had one damaged crank throw and center coupling section replaced, also completely refinished all over. We repair and refinish shafts of all sizes and types. Some damaged shafts straightened and the crankpins refinished in place. All types of heavy power plant and marine equipment serviced and repaired.

We give special attention to emergency work. Our services include experienced personnel available for on location inspection and work, or to recommend action. Our facilities include portable equipment and the ability to handle many types of cost saving field repairs.

We now manufacture a portable precision type crankpin refinishing machine for sale and invite your inquiries.

WASHINGTON IRON WORKS, INC.
Established 1876
SHERMAN, TEXAS

news of our industry

Great Northern Dieselizes

The complete dieselization of its 73-mile segment of mainline operation going through the Cascade Mountains will begin early this summer, Great Northern Railway announces. Completion is scheduled for August, 1956.

The project involves the 7.79-mi Cascade Tunnel, longest railway bore in the Western Hemisphere, and is expected to be almost entirely paid for by salvage from electrical installations and equipment now in use—overhead wires and electric locomotives.

Diesel operation through the tunnel will be made possible by installation of a ventilating system designed to eliminate motor fumes from the tunnel. It will include two 8-ft fans capable of providing 550,000 cu ft of air per min. Diesel locomotives will also be equipped with devices to spray cool water on radiators of the power units to avoid overheating while passing through the tunnel.

How to improve HEAVY FUELS

Writer "A" says:
"The most promising approach to the (corrosion) problem appears to be that of developing an additive to the oil."

Machinery builder "B" says:
"Additives have proved effective in reducing corrosion from vanadium"

Diesel operator "C" says:
"We used BARSAD during our last voyage and got good results . . . clear exhaust, good speed, less carbon deposits in the ports."

Machinery builder "D" says:
"We believe that BARSAD has interesting possibilities . . . (with respect to corrosion inhibiting) . . . it is particularly attractive in that it remains suspended in the fuel and does not require continuous mixing."

BARSAD is not just another sludge solvent type of additive for heavy fuels, but a completely new system to counteract the wear and corrosion caused by sulfur, vanadium, and sodium present in Bunker C and other heavy fuels.

If your diesels burn heavy fuels and cylinder and piston ring wear is excessive, it will pay you to use BARSAD.

If you operate gas turbines on heavy fuels, it will pay you to use BARSAD to counteract the corrosive effects of sulfur, vanadium, and sodium on nozzles and rotor buckets.

If you are getting pitting and corrosion of boiler tubes due to these corrosive elements, it will pay you to use BARSAD.

BARSAD

PAT. PENDING

For technical service, phone or write:

R. S. NORRIS & ASSOCIATES
26 VALLEY ROAD
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PHONE: LA2-4195

OR

GOLTEN MARINE COMPANY
455 CARROLL STREET
BROOKLYN 15, NEW YORK
PHONE: UL 5-7200

Buses Doom Canadian Trolleys

In Winnipeg, the end of this year will see the end of the electric streetcar era in street transportation. Orders have been placed for 100 diesel buses costing $2,460,000. Fifty are being built by Canada Car & Foundry Co., and the other 50 by Twin Coach Co.

The diesels are also edging out the trolley-buses which have been replacing the streetcars. When the new diesel buses are delivered, there will be 161 of them operating on Winnipeg's streets. One reason given for the diesel purchase is an expected increase in electric power rates.

REA Conference

The sixth annual meeting of REA-financed plant operators, recently held in Denver, has been acclaimed the most successful of these gatherings. The award for the most efficiently operated internal combustion engine plant went to M&A Electric Cooperative of Poplar Bluff, Mo.

Specific attractions to diesel plant personnel were prepared speeches by A. J. Poole, Jr., Bendix-Scintilla, on fuel injection equipment; D. D. Cook, Daros American Corp., on the influence of compression pressure on diesel efficiency; E. B. Rawlings, Cooper-Bessemer Corp., on diesel-residual fuel operation; and F. J. Sargent, Allied Oil Co., on the present and future availability of residual fuels suitable for diesel engines.

La Porte City Ups Capacity

Worthington Corp., announces it has been awarded a contract for an 840-kw dual-fuel electric set by La Porte City, Iowa. The new engine will be a Type SDRGO 6-cyl, 1195-hp, 450 rpm unit, direct-connected to an Electric Machinery Co. generator.

La Porte City first established its municipal plant in 1935 with Worthington diesels of 150- and 200-kw capacity. In 1939 a 350-kw unit was added, and capacity stepped up again in 1949 with a 550-kw set. This latest addition will bring total capacity to 2090 kw, reflecting about a six-time growth in city power needs over a 20-year period.

news of our industry

CNR Diesel Fleet Grows

One hundred thirteen new diesel engines were added to Canadian National Railways' fleet in 1954 and 170 coal burners retired, according to a report tabled in Canada's House of Commons. This additional dieselization permitted 46% of freight service and 60% of yard switching to be diesel-powered.

With dieselization of its freight service almost half completed, the report stated, the road was able to start a similar program for its passenger service. Of the new diesels acquired, 24 were assigned to passengers. Including those on order, the company expects to dieselize about 25% of its total passenger train mileage by mid-1955, compared with only 4% in 1954.

The continued switchover in 1954 left CNR at the end of the year with 1698 steamers for freight service and 435 for switching. It now has 615 diesels in service and 68 more on order.

Alcoa to Up Primary Capacity

Reflecting a move to bring primary capacity further into line with fabricating capacity, Aluminum Co. of America has decided to expand its existing reduction plants in Texas by 65,000 tons to raise its total capacity by nearly 10%. Point Comfort, operating on natural gas, is one of the two plants involved.

Railroad Hot Box Report

Recommendations for easing the problem of hot boxes were recently released by Armour Research Foundation of Illinois Institute of Technology after a 2-year study ordered by the Assn. of American Railroads. Hot boxes are generally caused when journal boxes become overheated by friction.

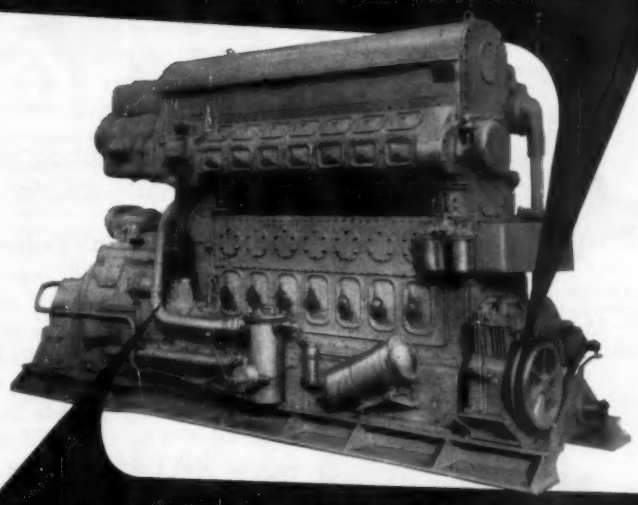
To improve journal bearing performance, it was advised that bearing fit on the journal be improved; that friction heat produced by the waste pack in the oil wick system which provides lubricating oil for the journal be eliminated; that improved cooling of the journal box be obtained; and that an oil having greater viscosity at high temperatures be used.

It was explained that the journal bearing is responsible for keeping the wheels of a freight car moving. The journal is part of a freight car axle that supports the bearing. The bearing assembly has no moving parts except for the rotating journal. An oil wick system feeds oil to the journal when the car moves.

Journal and bearing do not come into contact, but the freight car actually rides on a thin layer of oil. This condition depends on the viscosity of the oil which decreases as the oil gets hotter and available cooling fails to reduce the temperature. Together with unfavorable loose bearing fit, the viscosity reaches the point where the layer of oil becomes too thin, and a hot box occurs.

Another investigation of the foundation indicated that oil additives of the fatty acid type, especially oleic acid, provide the greatest friction reduction.

Quincy FOR DEPENDABLE STARTING



on this FAIRBANKS MORSE DIESEL

Fairbanks Morse & Co. selected a Quincy Compressor to supply compressed air for starting this new apposed piston diesel. Like other leading diesel engine manufacturers, Fairbanks Morse used a Quincy because it gives long life and trouble-free service.

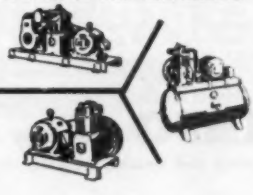
Specify a Quincy Compressor for your next diesel starting job. Compact, rugged Quincy Compressors will give you a dependable air supply.

There's a Quincy Compressor for every job. Let us help you select the right model from a variety of mountings and sizes from 1 to 90 C.F.M.

Write Dept. J-43, Quincy Compressor Co., Quincy, Illinois, for catalog on Quincy Compressors for diesel starting.

MAKERS OF THE WORLD'S FINEST AIR COMPRESSORS

QUINCY COMPRESSOR CO.
QUINCY, ILLINOIS

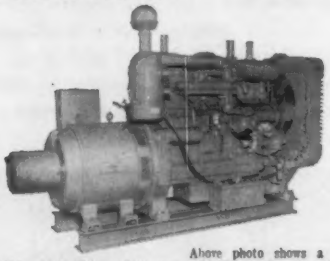


KATO

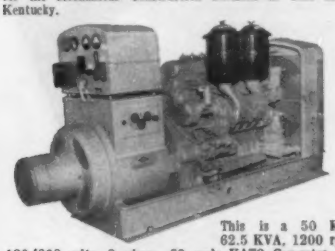
Continuous A.C. Standby Power

GENERATORS

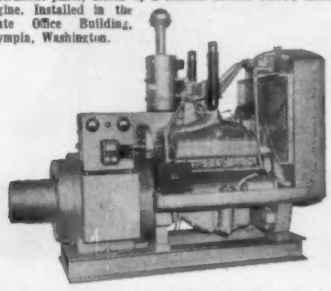
. . . a size and type to meet your needs to 400 kw



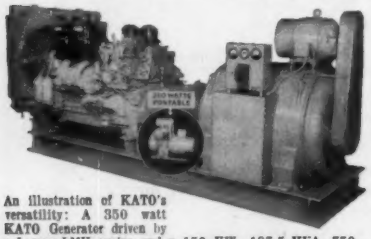
Above photo shows a 50 KW, 62.5 KVA, 1200 rpm, 120/208 volts, 3 phase, 60 cycle KATO Generators and instrument panel, driven by an International Model UD-18A diesel engine. Installed for the Mechanical Construction Division in Salt Lick, Kentucky.



This is a 50 KW, 62.5 KVA, 1200 rpm, 120/208 volts, 3 phase, 60 cycle KATO Generator and instrument panel, driven by a General Motors 6030C diesel engine. Installed in the State Office Building, Olympia, Washington.



This pictures a 75 KW, 93.5 KVA, 1800 rpm, 240 volts, 3 phase, 60 cycle KATO Generator and instrument panel, driven by an H-540 LeRoi engine utilizing natural gas for fuel. Installed for Republic Steel Corporation of Gary, Ind.



An illustration of KATO's versatility: A 350 watt KATO Generator driven by a Lauson LMH engine and a 150 KW, 187.5 KVA, 750 rpm, 120/208 volts, 3 phase, 25 cycle KATO Generator and instrument panel—driven by a General Motors twin 6-71 diesel engine. For Duluth, Mesabi & Iron Range Railway.

Your Inquiries Invited.

Builders of Fine Electrical Machinery Since 1928

KATO *Engineering Company*

1408 First Avenue, Mankato, Minnesota

news of our industry

AERA Convention

Engine rebuilders and producers of automotive replacement parts and shop equipment recently gathered in Cleveland for the 33rd annual convention of the Automotive Engine Rebuilders Assn. The 3-day meeting was equally divided between program sessions and manufacturer conference periods.

Highlight of the program was a symposium on the lubrication of rebuilt engines, a subject of intense interest to all members of the automotive service industry. Panel discussions on expanding markets and valve failures and correct procedures also received favorable comment. Sessions on camshaft grinding and shop kinks were of special interest to shop operators. To retain valuable data in these discussions, proceedings of the convention will be reproduced in booklet form.

CNR Orders First Trainmaster

The biggest diesel locomotive ever ordered by a Canadian railroad, a 2400-hp Trainmaster, is to be built for Canadian National Railways by the Canadian Locomotive Co. It is considerably larger than the conventional 1600-hp units CNR is now using. The Fairbanks-Morse product, designed as a general purpose locomotive, can be used for switching, freight, and passenger service. The road did not indicate where the unit will be placed.

Trio Study Pennsy Operation

With 75% of its service dieselized, the Pennsylvania Railroad is instituting a survey directed toward the elimination of its remaining small segment of steam operation. Undertaken in conjunction with General Electric Co. and Westinghouse Electric Corp., the study is expected to decide the future role of electric power in the road's operation. It will determine whether electrification will be expanded, limited to its present scope, or cut back. Maximum utilization of the road's diesel fleet will be a major objective.

Parts Degreasing Protection

Woodward Governor Co. has developed an insert for wire baskets so that parts being degreased are not touched by metal. The inserts are made of Masonite tempered Presdwood, with the bottoms perforated and the dividers slotted to fit together and form an "egg crate" grid. Parts put into the baskets can touch only the hardboard, not each other or the wire basket.

The company uses the material for inserts because of its inexpensiveness and its immunity to vapor degreaser fluid. Divider strips are cut in various positions for different assembly sizes. Some types have panels with larger holes to hold small cylindrical parts upright.

New Surplus Disposal Method

To dispose of more than $24 million-worth of surplus construction and mining equipment owned by Aluminum Co. of Canada, S&S Machinery Co., 140 53rd St., Brooklyn, N. Y., is offering a barter deal to countries which are short on dollars and long on resources. Alcan selected the company to sell over 50,000 different items of equipment used to build its huge power facilities at Kitimat, B. C.

The barter deal, according to S&S is just one phase of disposal plans to avoid the undermining of markets by dumping. Along with the barter deals for foreign countries, an American customer will have his choice of direct cash purchase or renting or buying on time. Evidence that the program is working well is that more than $1 million was realized in the first 10 weeks of the sale, which is expected to last for at least another year.

Railroad Receives Baldwin

Baldwin-Lima-Hamilton Corp. announces that the Montana Western Railway Co. has purchased an 80-ton diesel-electric locomotive powered by two 275-hp, 6-cyl, Cummins diesels. The locomotive will develop a continuous tractive effort of 24,800 lb at 5 mph, with a maximum speed of 42 mph.

new products

Socketless Hose Kits

The introduction of two redesigned socketless fittings and hose kits has been announced by Aeroquip Corp., Jackson, Mich., to replace the cardboard models that were made available some months ago. Kits Nos. 5143 and 5144 (replacing 5139 and 5140) are made of steel and contain an assortment that includes several new fittings and adapters.

The kits measure 12½ in by 12½ in by 6½ in and have a hinged top, removable compartment tray, attached ruler, and fitting identification chart. No. 5143 holds 71, ¼-in fittings and 24 ft of hoseline on a revolving reel. No. 5144 contains an assortment of 93 fittings, including both ¼- and ⅜-in sizes and types, and two spools of 24-ft coils.

Both kits are designed for use by large automotive shops and industrial plant maintenance departments. Featuring speed and ease of assembly, the bulk hose is cut to required length and pushed on the socketless fitting by hand. Clamps or other holding devices are unnecessary. The hose and fittings are rated at 250 psi, with burst pressure over 1000 psi.

Metal Lubricant

For drilling, tapping, or reaming all metals, Protective Coatings, Inc., Box 3985, Detroit 27, Mich., has come out with Metalube. Use of the lubricant is said to produce smooth and clean holes, and scrap in smooth spirals instead of chips.

The product, according to the company, will produce more holes from drills, more threads from taps, and more finished parts from reamers. It comes in a tube for bench use and may also be obtained up to 5-gal size.

Automatically stops the engine . . . if cooling water temperature goes above, or lube oil pressure goes below safe limits. This Sylphon Safety Control No. 530 will shut down small diesel engines direct and sound alarm, or serve as pilot valve to stop gas engines.

Automatically sounds an alarm . . . if water jacket temperature goes above, or lube oil pressure goes below safe limits. Or, this No. 539 Temperature-Pressure Switch will flash a warning light . . . or, if desired, shut down engine operation. "Fail-safe" feature.

Why risk engine trouble?

GET SYLPHON CONTROLS' PROTECTION

PLANT OPERATORS AND ENGINEERS find Sylphon Controls are big helps in guarding internal combustion engines against costly damage and shutdowns. These controls *stay* on duty round-the-clock—when *you* can't be on hand. Find out about these dependable, money-saving, long-lasting Sylphon Safety Controls. Write today for information. Ask for Catalog AD-817.

Robertshaw-Fulton
CONTROLS COMPANY

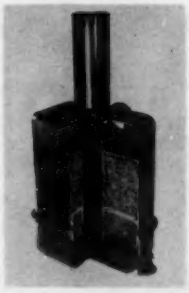
FULTON SYLPHON DIVISION • KNOXVILLE 1, TENN.

new products

Diesel Oil-Bath Air Cleaner

To meet space limitation problems and increased air requirements, United Specialties Co., 9705 Cottage Grove Ave., Chicago 28, Ill., has come out with a rectangular-shaped air cleaner. This shape is said to permit most efficient use of available space and contain more surface area than conventional circular cleaners.

The new cleaner has been put to



use on International Harvester's TD-24, TD-18A, and TD-14A tractors, which have recently been produced.

As shown in the cutaway view, the inlet stack is immersed part way in the oil bath so that air flowing through must first displace the oil before going through the filter elements.

There is a baffle arrangement in this area to divide the oil cup into an active and inactive zone. The inactive section is the first dirt settling area. The active section circulates oil for further settlement of dirt. Above this are two filter elements, one a removable scrubber type and the other a fixed pack element, both made from small wire springs.

For maintenance, there are two side bolts that loosen to drop the oil pan. The scrubber element is held in place by a center screw. Current sizes range from 5¾ in by 9½ in to 11½ in by 19½ in, and air capacities from 175 cfm to 740 cfm.

Vernier Depth Gauge

Holes as small as 1/32-in diam are measurable with the new depth gauges being marketed by George Scherr Co., 200 Lafayette St., New York 12, N. Y. The gauges are also claimed responsive to the most delicate touch, adjusting instantly to zero and point adjustment by a small set screw.

In operation, a hardened pin, held by the set screw, is used as the feeler point. To avoid error, an open slide permits view of entire scale. Two models of 3- and 6- in measuring capacity are currently being offered.

Soft Soldering Flux Kit

Alpha Metals, Inc., 56 Water St., Jersey City 4, N. J., is offering a general purpose soldering flux kit designed as a time saver. It contains a set of the most used fluxes including printed circuit, electronic, and general purpose fluxes.

With the kit, rapid determination of the proper flux for a soldering job is enabled, it is stated. There are 16 controlled fluxes in all, each contained in labeled glass bottles. The carton flap holds a chart giving position and description of each flux in the carton. It sells for $6.50 per kit.

Good Temperature Control is essential

. . . TO HEAVY DUTY POWER!

Vernatherm thermostats assure *correct* operating temperature.

Solid charged and precision built, these thermostats have proved themselves in the field over and over again. They have proved that rough duty and rigid limitations need not mean frequent thermostat replacement!

Detroit Controls Corporation pioneered Vernatherm thermostats to meet the needs of modern pressurized cooling systems. They have solved a great number of tough problems on Diesel, heavy-duty gasoline and jet engines. Vernatherm controls might be the solution to a situation in *your* engines .

Call on DETROIT sales engineers for test data and actual field results . . . or write for Bulletin 213 which gives basic data on Vernatherm controls and their function in modern engine design.

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new products

New Enterprise Engine

The first Vee-type engine to be built by Enterprise Engine & Machinery Co., is now in production at the company's San Francisco plant. It is a 16-cyl, 6150-hp diesel, turning at 400 rpm, and is designed for municipal power applications, heavy-duty marine service, and large pipeline operation.

Fifth in the company's series, the new R-V incorporates opposite cylinders in the same plane, which decreased spacing, it is stated, reduces the overall engine length by as much as 20% of conventional design. The ratio of horsepower to weight, floor space, or cubic volume is also claimed greater over similar type and rating engines.

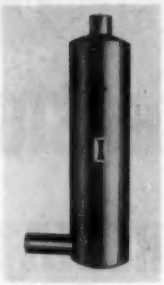
A major feature is design of the connecting rod and piston assembly to enable removal in entirety through the cylinder liner by release of six clamping bolts. This construction is said to reduce bearing loadings as well as stress on the clamping bolts. A new arrangement also provides for positive lube oil return from the cylinder head to the base.

To permit maximum bearing area without increasing total length of crankshaft, re-entrant fillet design is employed. The joint between the crankcase and base is metal to metal to eliminate gaskets and give rigid assembly. Cylinder blocks are interchangeable. Pushrods, tappets, camshafts, fuel injection pumps, and fuel headers are located for easy servicing accessibility. An added feature is 3-piece construction of the crankcase and blocks for shipping, installation, and maintenance ease.

Side-Inlet Muffler

Kittell Muffler and Engineering Co., Inc., has announced that its E.C. series muffler, recently available only with an end inlet, can now be obtained with side inlets at no additional cost. This new development will allow for more compact installation and greater space savings.

The E.C. series, developed for use with 2- and 4-cycle engines, has the



standard Kittell silencer design. In operation, as a burst enters the silencer it is quickly bled off by means of a perforated tube, a feature said to completely eliminate power loss due to atmospheric back-surge. The exhaust gases are then directed through a series of louvres along the outer shell, which cools them and reduces their volume. They are then directed back through more louvres into the silencer center and out to the atmosphere. This controlled expansion smooths out pulsations to lower the noise level of the exhaust flow.

Left-Hand Insert Shop Packs

Stainless steel wire thread inserts in shop-pack units for repairing left-hand threads in the 7/16-20 and ½-20 sizes are being made available by Heli-Coil Corp., Shelter Rock Lane, Danbury, Conn. This makes a total of 29 different shop packs the company has introduced. Each contains a quantity of inserts, tap, and inserting tool in a metal-edged box.

Geared-Head Wrench

For heavy assembly and disassembly work requiring rotary effort over 200 ft lb, Bonney Forge & Tool Works, Allentown, Pa., is introducing the X-4, a 4-to-1-ratio geared-head wrench. An intermediate unit, it is designed for use with ratchets, torque wrenches, sockets, and attachments. Torque is produced through planetary gears.

No dangerous snap or jarring is said to result when it is used in tightening or loosening threaded parts. It has a drop-forged, chrome-moly steel head and all stressed parts, including its detachable anchor bar, are made of heat-treated alloy steels. Heads and shafts are "sealed and lubricated for life".

★ for DIESEL LUBE & FUEL OILS

NEW Honan-Crane **Full Flow Filters** give you **EXTRA HIGH flow rates— 25 to 900 GPM!**

plus *these time and money saving features*

Greater Filtering Efficiency
Designed for in-line installation. Every drop of oil in the system gets continuous filtration . . . solid particles down to micronic size (1 micron: 0.00004") are removed.

Large Dirt Holding Capacity
Uses remarkable new "Flo-Pac" Cartridge—a product of two years' research. Cartridge contains 44 square feet of filtering surface . . . has exceptionally long life.

Rugged Construction—Built of heavy gage, formed steel for heavy-duty service with a minimum of upkeep. No moving parts. Special cover and cartridge gasket seals eliminate leakage and bypassing of oil.

Sizes to Meet All Flow Requirements—The Honan-Crane Full Flow Filter is available in nine compact models using one to 36 "Flo-Pac" Cartridges. Flow rates range from 25 to 900 GPM to provide "custom" filtration in any application, large or small. Completely inert cartridge will not remove additives or inhibitors.

QUICK OPENING COVERS

Covers are fastened by swing bolts which can be loosened in seconds. Larger models have unique lifting device that raises and swings cover to one side for easy access to cartridges.

Write for 8-page Equipment Bulletin 101 giving full details.

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FILTRATION DIVISION
a subsidiary of HOUDAILLE-HERSHEY CORP.

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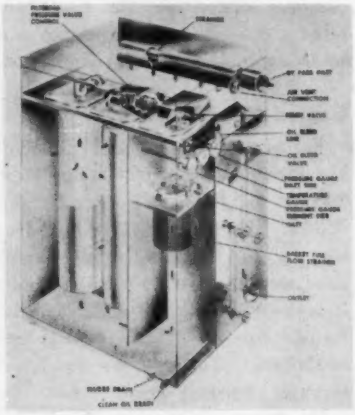
SELF CONTAINED FILTER AND TANK

The Briggs CD type clarifier is a compact unit embodying full-flow oil strainers, cartridges to suit the individual requirements, and an oil reservoir, all within one rectangular steel tank. Built-in relief valves are permanently set to maintain correct pressure differential on the filter cartridge for peak "oil conditioning."



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Send me all the information you have on CD type filters.

NAME .....

COMPANY .....

ADDRESS .....

(city) (zone) (state)

new products

International Earthmover

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has begun marketing the largest high-speed, rubber-tired earthmover in its line. Called the 75 Payscraper, it is powered by a 262-hp diesel engine, and is capable of scooping up an 18-cu yd heaped load and highballing along at more than 24 mph.

To take care of this boost in engine power, the company has strengthened its conventional power train and increased gear reduction at the final drive to put less torque in the transmission and reduce shock loads. Radiator capacity has also been increased for greater cooling of the larger engine. A new compressor, new governor controls, and a new air line arrangement has also improved the air system. Other features are improved hydraulic steering, a new disc-type cable control, and a new air-assisted clutch release.

Rubberized Abrasives Kit

To handle deburring, smoothing, and polishing applications, Cartex Mfg. Co., 81 Natoma St., San Francisco 5, Cal., has developed an abrasive polishing kit. An assortment of 24 polishing wheels, cones, blocks, and mandrels are contained.

The abrasives are of four grit types ranging from coarse to extra fine. Included are specific items needed to polish and smooth combustion chambers, ports, valves, pistons, connecting rods, rocker arms, gears, splines, crankshafts, and other engine parts. Other items are used for various other industrial applications such as removing film, coatings and enamel, blending in and polishing rough seams after grinding, and removing rust, tarnish, and scratches.

new products

7-Yard Scraper

Latest addition to its line of motor scrapers, the Model S-7, is now in production by the Euclid Div., General Motors Corp., Cleveland 17, Ohio. Powered by a 143-hp diesel, with a 5-speed transmission, it is the first overhung engine scraper of the company.

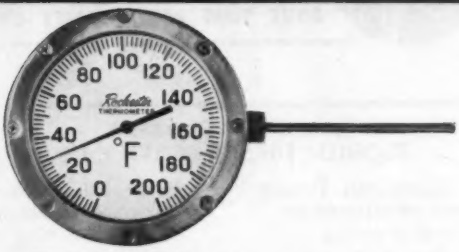
All scraper operations are controlled by hydraulic lever action. Major components are accessible for servicing and may be repaired without major disassembly. Tires are 18 by 24, 16-ply; and are available 21 by 25 for jobs requiring maximum traction and flotation. This latest model gives Euclid a scraper line with 7-, 12-, 15½-, and 18-cu yd struck capacities.

Safety Switch for Hoists

To prevent overload damage to hoisting equipment, W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Cal., announces a 20,000-lb capacity device which automatically cuts out lifting power whenever the safety maximum is exceeded. This is done by means of a U-shaped steel bar attached between the load and the hoist. Whenever the bar is deflected beyond its pre-set operating point, it trips a micro-switch to break the lifting current.

Called Dyna-Switch, the device has a claimed accuracy of 0.5% with a 3½:1 safety factor to permit accidental overloads up to 70,000 lb without damage to calibration. The safety factor is managed by a free-riding stop bolt at the open end of the bar which restrains the bar against deflecting more than 21,000 lb even though much greater loads are imposed. For 110- or 220/440-v power supply, the instrument is 18¼-in long, 6¼-in high, and 2⅝-in deep.

For THERMOMETERS that are DURABLE, ACCURATE, ADJUSTABLE



USE

Rochester Dial Thermometers

Hermetically sealed against moisture and dirt to bring you years of trouble free service.

Recalibrate the dial externally by inserting the stem in liquid of known temperature and adjusting screw attachment.

Designed to be used indoors or out, the stainless steel case is impervious to most corrosive agents.

Rochester Straight-Form Thermometers bring you the added advantage of a stem that can be mounted in any position around the dial.

For additional information contact your Rochester sales engineer or write:

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you have only to indicate your requests on these postage free post cards

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void after July 15, 1955

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_____

described on pages ____ - ____ - ____ - ____ - ____

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COMPANY _____ POSITION _____

ADDRESS _____

☐ *please have a salesman call*

void after July 15, 1955

Please rush me further information on the following products

_____

_____

described on pages ____ - ____ - ____ - ____ - ____

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A reader service department is now established to serve your needs

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new products

High-Speed Rotary Switches

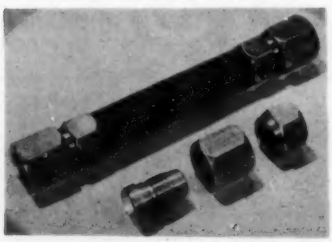
Suitable for use as overspeed or underspeed limit controls, Syncro-Snap rotary switches, recently announced by Torq Engineered Products, Inc., Interstate St., Bedford, Ohio, are claimed to provide instant cut-in or cut-out characteristics. Snap-type switching action is completed within 3 rpm of the shaft to which the switch is attached, the manufacturer also claims.

Presently furnished for any speed up to 13,000 rpm, the control devices can be obtained to specification in open, closed, or explosion-proof housings. They operate on a patented principle which requires a decreasing amount of force for actuation as the critical speed is approached. Centrifugal force, at the same time, increases by the square of the speed of the shaft. These combine to give the action at the set speed.

Fiber-Braid Hose and Fittings

Rubber-covered, single fiber-braid (non-metallic) hose for low pressure service, and brass reusable fittings for this hose, have been added to the line of Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio. The hose is used in service with hydraulic fluids, diesel fuel, water, gasoline, and air.

The fittings make skiving of the hose unnecessary in assembly. Hose sizes for 1/4-, 3/8-, 1/2-, and 5/8-in ID are offered. Temperature range is -65°F to 160°F. There are three body types of fittings available: 45-deg flare end, 45-deg flare swivel nut, and male pipe thread. Detailed information is given in catalogs 4480A and 4484A.



What Do You Know!

(*Answers to Questions on page 57*)

1. Correct answer is "c". Sharp exhaust slug pressure fronts are broken up in the turbine and released at a lower energy level. There are two mentions of this: in the article on Page 56 and the one on Page 32.

2. Correct answers are "b" and "d". Weight distribution is important for steering characteristics, best suspension, and adjusting axle loading for maximum payload capacity. Accessibility for maintenance is an obvious advantage. See Page 56.

3. Correct answers are "c" and "d". Most engine irregularities are reflected in oil pressure and/or cooling water temperature. As to "e", many long-running engines do not have battery charging generators. See the article on Page 37 for discussion of a protective system.

4. Correct answer is "b". Although mechanically independent, turbochargers are self-regulating. Energy in exhaust gas available to them is directly proportionate to engine load. For a complete discussion see article on Page 32.

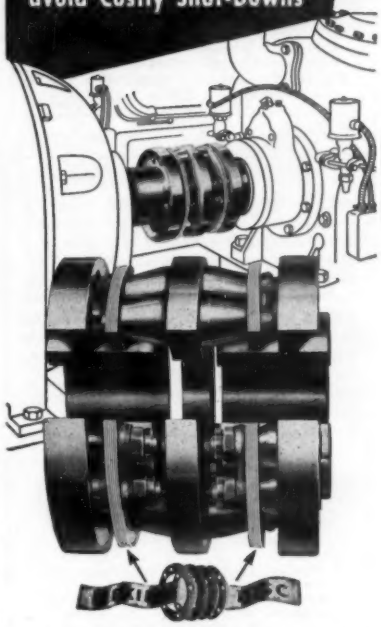
5. Correct answer is "b". The attendant cooling effect of turbocharging despite high power outputs has proven beneficial to engine life in many cases. See article above.

6. Again, correct answer is "b". This is a sleeper. "Maximum" is the key word. Some tightening specifications (see article on Page 50 for example) provide for different torque settings of head bolts.

7. "Valve seats, liners, and press fits" should be the proper sequence to match respectively with welding, plating, and metal spraying. See article on Page 46 for details.

8. Correct answer is "d". One major battery manufacturer specifies this limit. See Page 58 for details.

Specify THOMAS ALL METAL FLEXIBLE COUPLINGS for Power Transmission to avoid Costly Shut-Downs



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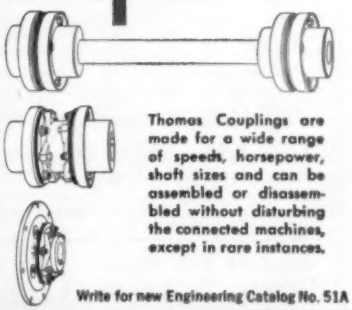

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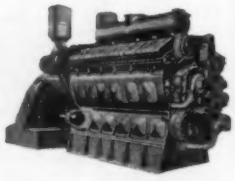
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organizational news

C. H. Kimmel

M. J. Hoke

Ohio Crankshaft Names Two

At a board of directors meeting of The Ohio Crankshaft Co., C. H. Kimmel was elected president, and M. J. Hoke was named vice president and general manager of the crankshaft and camshaft division. Mr. W. C. Dunn, co-founder and president of the company since 1920, will continue in the capacity of board chairman.

Mr. Kimmel came to the company in 1940 as factory manager of its crankshaft and camshaft division. In 1946 he was advanced to general manager. He became a vice president in 1952, and vice president and general manager of the entire company in 1953.

Mr. Hoke first associated with Ohio in 1945 as a development engineer. In 1947 he was made chief engineer. The following year he became works manager, and in 1953 general manager of the crankshaft and camshaft division.

Le Roi Sales Promotion Head

Glenn W. Graf has advanced to the post of sales promotion manager of Le Roi Div., Westinghouse Air Brake Co., succeeding Richard H. Koehler who was recently moved up as advertising and publicity director of the parent company.

Glenn W. Graf

Mr. Graf has been in the Milwaukee division's sales promotion department for more than two years. Prior to that he worked with Bucyrus-Erie. His background also includes newspaper and radio work.

Aeroquip Acquires Marman

The acquisition of Marman Products, Inc. as a subsidiary operation has been announced by Aeroquip Corp. Marman makes clamps and couplings mainly for application in the aircraft field. Aeroquip intends to introduce them into the industrial markets it now serves.

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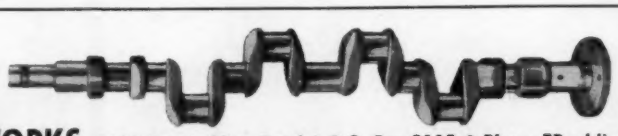
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organizational news

Air-Maze Sales Additions

Two new appointments to home office sales positions have been announced by Air-Maze Corp.

Bruce W. Carkin is now sales engineer of railroad and original equipment installations. He was formerly with the Electro-Motive Div. of GM, associated with design and development of locomotives. Bennett T. Church has been named manager of distributor sales. He previously served with Harvey Whipple, Inc. as a factory representative.

Eaton Advertising Director

The former sales promotion manager of Eaton Mfg. Co., Richard H. Gale, has advanced to a newly created position. As director of advertising, he will supervise all advertising, sales promotion and publicity activities.

Mr. Gale was first employed by Eaton in 1929. After 11 years in the service department of the Axle Div., he was transferred to axle sales where he handled advertising and sales promotion. He was appointed sales promotion manager for the entire corporation in 1952.

H. H. Warren

E. A. Holland

Exide Sales Promotions

Two organizational changes have occurred in sales at the Electric Storage Battery Co. H. H. Warren now occupies the post of assistant sales manager of the Exide Industrial Div., with Edward A. Holland taking over his former position of assistant manager of the New York sales branch.

Mr. Warren has been with the company since 1921, starting as a battery assembler. His first sales position came in 1925 and in 1933 he was made an automotive replacement field salesman. He became industrial products salesman in 1945 and was named assistant manager in 1948.

Starting as a clerk in the New York sales office in 1937, Mr. Holland was promoted to battery replacement salesman in 1941. His latest position, industrial sales engineer, was given to him in 1949.

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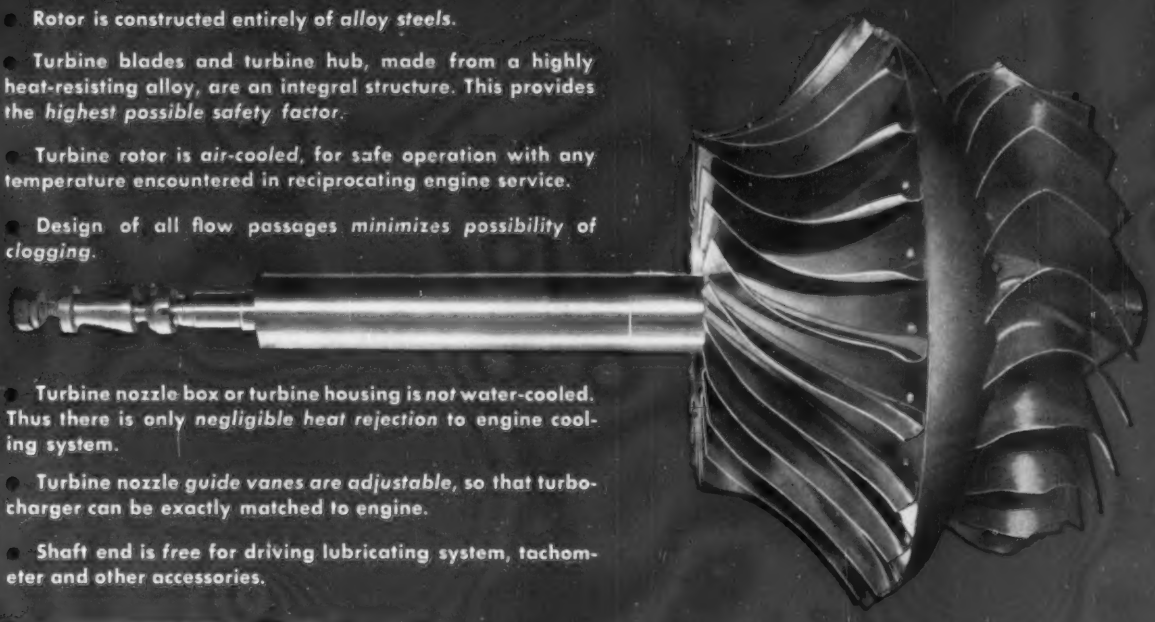

- Turbine nozzle box or turbine housing is *not* water-cooled. Thus there is only *negligible heat rejection* to engine cooling system.
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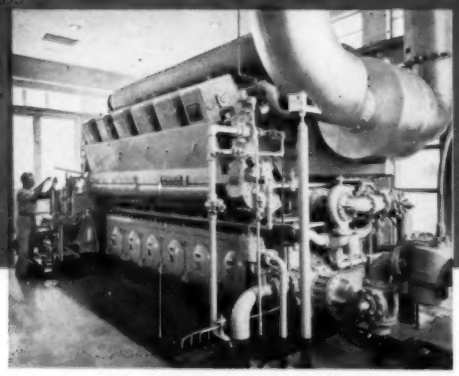
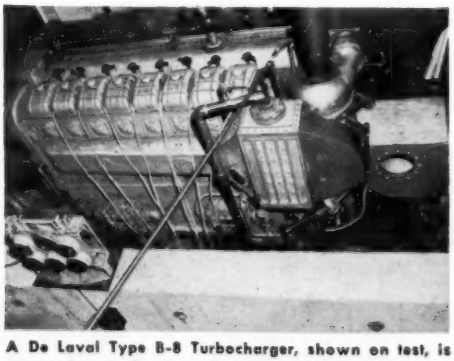


Here is a De Laval Type A-14 Turbocharger installed on a V 12-cylinder, 4-cycle diesel engine.



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